JUNE 20, 1936

ELECTRICAL WORLD

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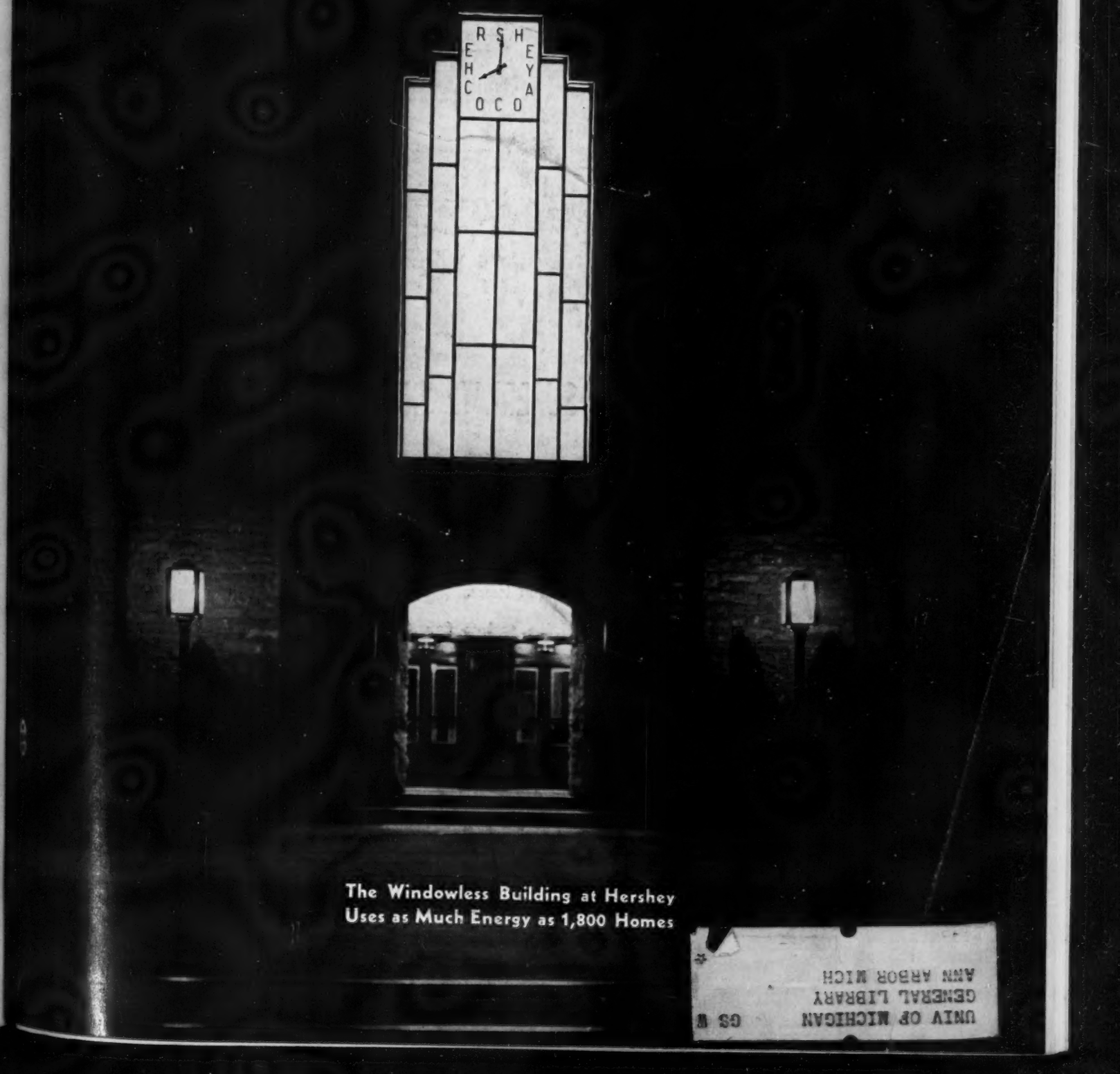

The Windowless Building at Hershey Uses as Much Energy as 1,800 Homes

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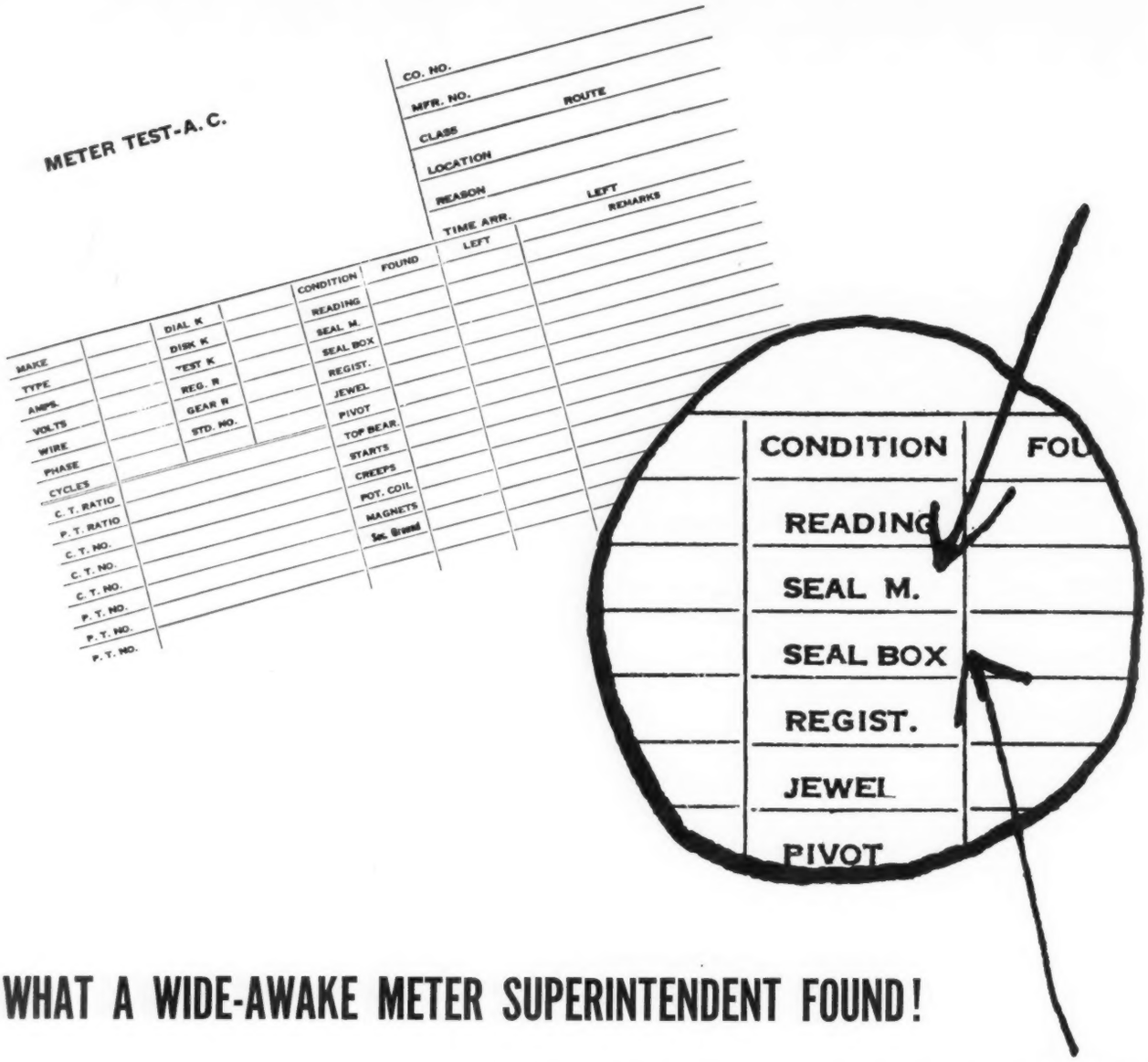
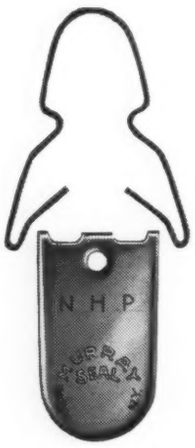


WHAT A WIDE-AWAKE METER SUPERINTENDENT FOUND!



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ELECTRICAL WORLD

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Reader's Guide to This Issue

Articles covering a wide range of subjects of vital interest to the industry today are presented in this issue of Electrical World. An abstract of a paper by Frank F. Fowle, editor-in-chief of the Standard Handbook for Electrical Engineers, dealing with the economics of power supply, heads the list. A new and desirable commercial load source is discussed in an article on the Hershey windowless office-building. Suggestions as to possible ways to reduce distribution costs are presented by a noted engineer. The much-discussed and highly problematical subject of rural policy is covered by Graham Claytor. And finally, accurate and reliable statistics on electrical output and revenue for the entire country are given.

Of Executive Interest

Lighting Load de Luxe—Facts on Distribution Costs—Good Neighbor Rural Policy—The Nation's Power Supply—Utility Revenue Up 6.3 per Cent

For Power Company Engineers

Facts on Distribution Costs—Aerial Survey Aids Electrification Project — The Nation's Power Supply

On Power Company Sales

Lighting Load de Luxe—Facts on Distribution Costs—Good Neighbor Rural Policy — Do Home Lighting Advisers Pay?—Laundry Data Sheets

For Electrical Engineers

Lighting Load de Luxe—Flicker Reduced by New Reactor Starter—Electrodes Coated In Conditioned Air—Electric Heat Aids Sealing of Batteries

For Electrical Manufacturers

Lighting Load de Luxe—Facts on Distribution Costs—Nation's Power Supply — Electrodes Coated In Conditioned Air—Oscillograph Has High Film Speed

CONTENTS

JUNE 20, 1936

Lighting Load de Luxe 29
An office building without windows! Seemingly a paradox, it is an accomplished fact at Hershey, Pa. This article describes fully the lighting and air conditioning installations that have made this innovation in office buildings a success from every angle.

Facts on Distribution Costs 32
Howard P. Seelye faces the facts of distribution costs and discusses them from the viewpoint of what distribution costs have been and what they should be. He indicates where economies may be made and presents suggestions for improvement.

Good Neighbor Rural Policy 35
Straight thinking on the part of vice-president Graham Claytor of the American Gas and Electric Company has evolved a common-sense rural policy which takes into account the farmers income, necessary engineering economies and the rural cooperatives.

Aerial Survey Aids Electrification Project 37
Fourteen hours of flying time produced a photographic map of 410 square miles of territory that greatly simplified the job of estimating the cost of projecting a rural distribution system in Polk County, Oregon. Just how much work this survey saved is told in this article.

The Nation's Power Supply 38
Here ELECTRICAL WORLD presents an abstract of Frank F. Fowle's paper which created widespread interest when presented at the recent Midwest Power Engineering Conference at Chicago. Facts are presented here to show the fallacy of the government's power program by proving that the transmission of remote hydro power is costlier than coal haul.

Utility Revenue Up 6.3 per Cent . . . 45
Monthly revenue and output figures for the month of April

Carter Field on Washington Events . 48

Editorials . . . . . 27 and 46
News of the Week . . . 50
Operating Practices . . 60
Power at Work 64
Laundry Data Sheets . 67
Engineering Ideas . . 68
Building the Load . . . 73
Men of the Industry . 76
New Equipment 80
Recent Rate Changes 84
Municipal Items 86
Book Reviews 88
Sales Opportunities . . 98

Coming Features

Oil Refineries Use More Electric Power

Richard Henry of Empire Oil & Refining Company tells of the explosion-proof equipment, unit assemblies of motors, variable speed drives, etc., that have increased the desirability of electrical applications in oil refineries. Small investment by the customer is given by Mr. Henry as an important factor in decisions to use purchased power in this field.

Semi-Outdoor Steam Station

Utah Power & Light is to install an 18,750 kw. steam plant of unusual design. Being semi-outdoor in design, structural costs are reduced by a substantial amount as compared with usual practice. Louis Elliott of Elbasco Services will describe all features of the station in an early issue.

New York Merchandising Plan

A new cooperative merchandising plan recently placed in effect by the New York Edison Company involves a partnership between the utility, the manufacturer, the distributor and the retail appliance dealer. Phases of the plan are new and completely different. The whole plan is described in a coming story by E. F. Jeffe of the New York Edison Company.

Telemetering Scheme for Intercompany Ties

Tennessee has developed a system with versatile characteristics functioning at 5,000 cycles and at 60 cycles for metering intercompany tie lines where the tie may be located 100 miles or more from the dispatching office. E. E. George tells about it.

T.V.A. Rural Lines

T.V.A. Engineers Evans, Daniels, and Burk tell what goes into their rural distribution lines. They give their reasons for the selection of long spans, common neutral 11,950-volt, 4-wire system, single bushing transformers and a unique simplified construction.

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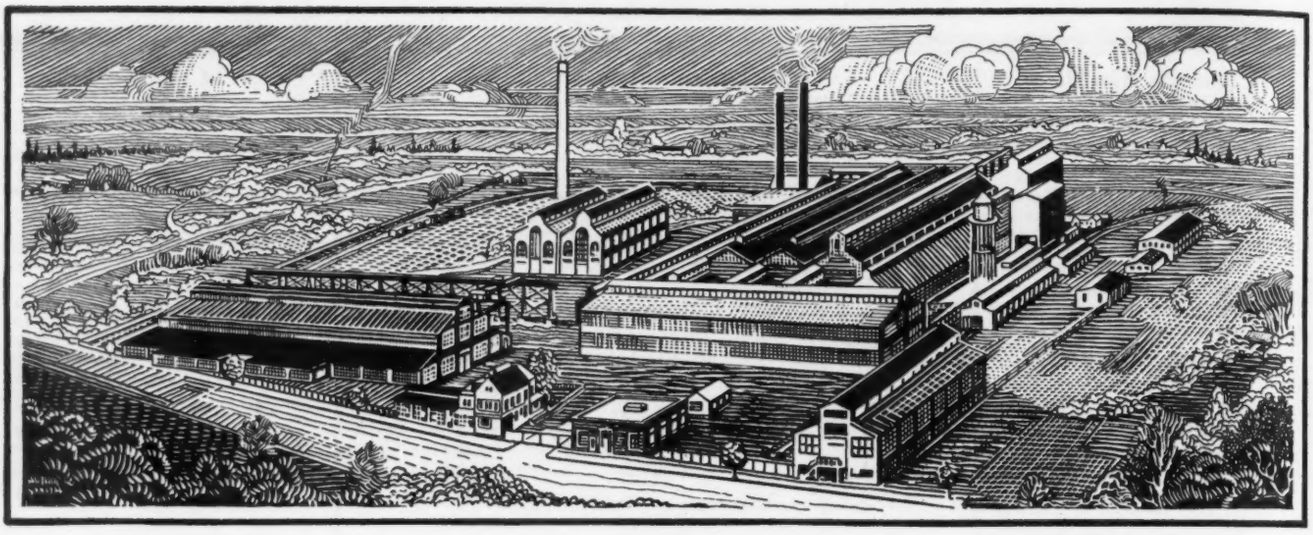

EVEN during the long economic depression, large research expenditures were made by Okonite-Callender to produce new cables for the already perceptible new trends. The entire field was covered, from distribution to super-tension voltages, and many new features and improvements were developed.

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ELECTRICAL WORLD

MANAGEMENT • ENGINEERING • OPERATION • UTILIZATION

PUBLISHED EVERY SATURDAY

JUNE 20, 1936

A Western Yankee Goes to Bat

The Republicans have written their platform and selected their candidate. Electrical men should be encouraged by both from the point of view of industry progress. The platform is liberal, but fair. It is against monopoly, it is for regulation of interstate utility business, it is against government competition in business and it announces sound policies on currency, spending and social legislation.

Governor Landon, from his record, believes in fair, but strict, utility regulation and has complete faith in private enterprise and initiative. He appears to be a level-headed business man with liberal views, but without outstanding or spectacular qualities—a kind of Western Yankee. He has reduced Kansas taxes 32 per cent and the cost of the state government 22 per cent below the 1929 values.

With no political partisanship, we believe this convention was indicative of a positive change in public sentiment. Sane-thinking Americans are responding to the needs of the times. We hope the coming Democratic convention will be equally constructive in its platform and that the present Administration will change its attitude if returned to office.

As good citizens, it is imperative that all electrical men do their part in the coming campaign. But we hope attention will not turn to politics entirely. There is business to be had, construction to be done, and there should be no let-down in the program to make this a record year in industry progress. Both the E.E.I. and the N.E.M.A. conventions afforded the evidence that the industry is revived and hard at work in an effort to make profits. It should continue this program.

In this connection a word of warning should be issued to the utilities. The energy output this summer is astounding. We predict the late season peak and output will create a crisis in capacity on many utility properties. Now is the time to prepare for this coming load.

One aspect of industry developments will be discussed at the A.I.E.E. convention in Pasadena. Engineers and research men are active these days in bringing out new or improved equipment. They have developed ways and means to modernize much of the old equipment so that it will give better service and have greater capacity. Their contribution should help the industry to carry the coming peak load and also provide new tools to expand the business. The silliest conclusion we hear is the statement that engineering is static and finished. We predict greater technological obsolescence in the industry during the next five years than in any corresponding period.

Hospitality will be shown to a host of foreign visitors attending the World Power Conference in September. We doubt if many of us appreciate the importance of this meeting or its value in creating international good will. All the nations of the world are represented by official delegates appointed by their governments. They are engineering and business leaders. They create the real international business sentiment of the world in matters technological. We should put our best foot forward in showing them a good time and let them see the feats we have accomplished. We can learn as well as teach at a conference of this caliber.

Fred Morrow

Editor

Wide World

INSIDE NORRIS DAM SCROLL CASE

Swirling water from the penstock passes through the wicket gates to the right of the workman and on into the turbine to develop part of the 100,000 kw. output from the two generators. Power at Norris Dam is expected to be available in the early fall.

Lighting Load de Luxe

Windowless Office Building at Hershey, Pa., Costs Less to Build and Less to Operate Than Conventional Office Building

"The windowless building at Hershey." Topic of conversation among business men, no less among utility men. What is it really like inside and out? Would you like to work there yourself? Is it an ideal electric load? What are the things that would interest an electrical man? Forthwith, "Electrical World" goes to Hershey, looks, sees, and supplies some answers.

THE question most frequently asked by the visitor to Hershey is this: Why construct a windowless office building in a model community such as this, in the valley of the Lebanon, in a green, rolling country fringed by the foothills of the Blue Ridge? You see Founder M. S. Hershey, clear-eyed, alert at 78, coursing around town—not in a Stanley Steamer—in the very latest streamliner, no less. Across the street is a six-story Community Building that looks like the Boca Raton Club in Florida, but which, unlike the Boca Raton Club, has a membership fee of $3 to $12 per year. Up in the Hershey Hills are the Industrial School and 36 farm-home units scattered over 9,000 acres, created for 910 orphan and half-orphan boys. The Community Building went up in 1929, the industrial school in 1934; an excellent mountain-top hotel was opened in May, 1933. These facts partly answer the question of why a windowless building in Hershey.

Its exterior, familiar to many, is shown on the cover of this issue. The "windows" are not windows, but translucent panels 36 ft. high, which, lighted, diffuse an amber glow.

Entering the lobby, pictured here, is like entering an ultra-modern public library. It is quiet and restrained, modern and modernistic. The walls are cool green, the visitors' seats vivid blocks of red. Oil paintings on the wall seem very beautiful. Everything seems to be very clean. Up under the balcony glows an unusual shell-like light source, and away up near the ceiling are more light sources. Of which more later.

The offices are lighted differently from the lobby and details of the fixture are shown on page 29 as installed in an office shown on that same page. These are utilitarian lights giving a semblance to daylight that is striking.

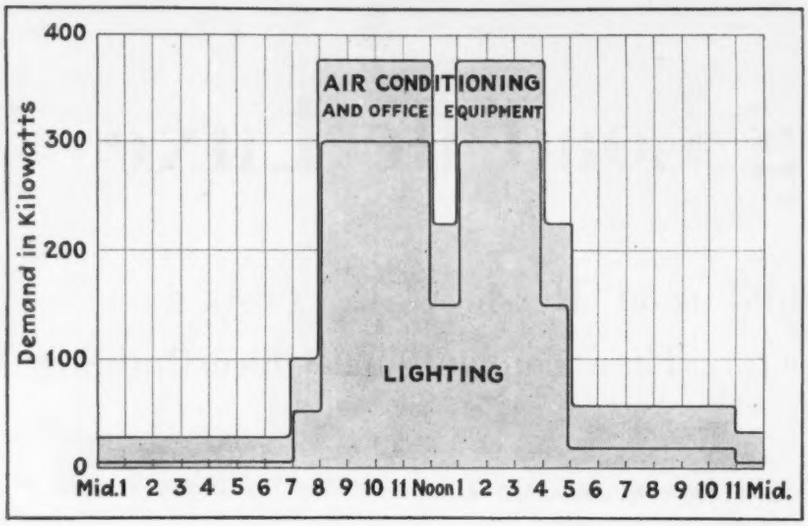
"Yes, I like them," replies a neat Hersheyite, at her modernistic desk. "I guess it's because it makes us girls look better." The stunning brunette receptionist in the lobby likes to work in the windowless building because, "Oh, I was one of those persons who was *always* catching colds in the office."

The daily load

With air conditioning, and lighting fixtures each with a capacity of more than a kilowatt, the building would seem to be an appliance salesman's paradise. Unfortunately, a demand meter had not yet been placed on the building supply lines. But Chief Engineer A. Bowman Snavely's records showed a daily consumption of 3,720 kw.-hr., and from this figure a synthetic load curve was constructed, as shown on page 28, and the daily load factor was computed to be 41.3 per cent.

A word of explanation is necessary here. Workmen were busy installing

Entrance and lobby, located just inside front entrance



Proximate daily load curve

This is the first authentic information which has been available as to the daily load characteristics of the windowless building at Hershey, Pa. From a starting point of a daily usage of 3,720 kw.-hr., A. Bowman Snavely, chief engineer of the Hershey Chocolate Corporation, and Frank Magrini, electrical engineer of the corporation, constructed this proximate daily load curve. This depicts present operations on a typical day as the building is operating at the present writing.

equipment for a printing plant, fitting up locker rooms and welfare service departments for employees, making ready a storage room for the finished product. At present writing, however, the building offers an up-to-the-minute example of a typical windowless *office building* load, and thus is of more value to a larger number of readers.

The air-conditioning, lighting and office appliance load and its daily characteristics apply to the building as it is now, solely an office building. The contents currently used in this four-story, 350x150-ft. building are roughly one-third to one-half of the total.

Later a second air-conditioning unit is to be installed to care for the printing and other special facilities to be constructed in the building.

Office lighting features

The building is supplied at 2,300 volts, 60 cycles, three phase from two circuits, each coming from a separate power plant. A General Electric automatic change-over switch shifts the loads from one circuit over to the other in case of interruption.

The largest single element of load, lighting, presented to the lighting engineers the problem of furnishing a system not only equal to daylight in visual characteristics but satisfying the psychological necessity for an impression of bright cheerfulness that would offset any "shut-in" reaction.

First of all, there appeared to be both visual and psychological reasons why this lighting should approach the color characteristics of daylight as closely as is commercially practical. The color characteristics of light from ordinary incandescent lamps are admittedly considerably overbalanced toward the red end of the spectrum in comparison with daylight. While blue-glass bulbs or filters act to reduce this overabundance of red, the method is a "subtractive" one which reduces the efficiency of the lighting. The other alternative involves the use of mercury-vapor lighting combined with incandescent lamps.

The light from Cooper-Hewitt mercury-vapor tubes alone is generally admitted to be high in visual effectiveness, but its lack of red rays and overabundance of blue gives an unnatural effect to flesh tones and other colored objects that is psychologically disturbing for office lighting. A light unit combining one circular 30-in. mercury-vapor tube (300 watts) with one 750-watt incandescent lamp, however, produces a light which comes close to the color balance of daylight. Moreover, because the balance is obtained by an "additive" method, the units operate at an efficiency equal to that of an ordinary "unbalanced" light source of ordinary visual characteristics.

From the standpoint of light intensity it was decided that a level of 20 foot-candles at desk level throughout the offices represented the value to be achieved to assure individual eye comfort and working efficiency.

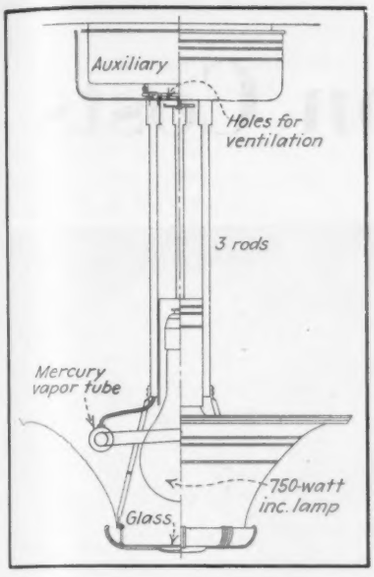
Obviously, the fact that this level is *uniformly maintained* day in and day out, on every desk from that of the president to that of the office boy, is a factor of great importance in assuring visual efficiency. On bright days there are no disturbing contrasts of sunlight and shadow. On dull days there is no question about "When shall we light the lights?" The eyes of workers who move from one part of the room to another need not constantly adjust themselves to major variations in the distribution of daylight across the room.

For the sections of the building which are devoted to executive and general offices 158 combination mercury-vapor incandescent luminaires of the type shown on page 29 were used. These luminaires were designed and manufactured by the Voigt Company of Philadelphia and are of the self-contained type, with the auxiliary for the mercury-vapor tube located in a canopy housing. Strikingly modern in appearance, they reflect 95 per cent of the light to the ceiling, 5 per cent being directed downward through a diffusing glass center section. This indirect method of lighting produces an even and practically shadowless light distribution throughout the working area.

The ceilings naturally play an important part in the efficiency of such a lighting system. Although chosen primarily for its sound absorption properties, the Armstrong "Corkoustic" ceiling, finished in ivory acoustic paint, is highly attractive in appearance and has a light reflection value as high as 75 per cent of the incident light totally reflected.

In one of the general offices 30 of the 1,050-watt combination luminaires are located in a room approximately 150x60 ft. (page 29), representing approximately 3.5 watts per square foot. They are spaced on 20-ft. centers in one direction and, due to the presence of air-conditioning ducts, approximately 14 ft. apart in the other.

In a number of the smaller offices and areas, where seeing tasks are particularly severe, the units are more closely spaced, ranging up to a value of 7 watts per foot. Ceilings in the general offices are 14 ft. high and the luminaires are dropped approximately 3 ft. below this level. In some of the smaller offices flat ceilings have been installed below the level of beams and air ducts, making it possible to utilize a luminaire of slightly different design,



Details of office lighting fixture, capacity 1,050 watts

in which the auxiliary for the mercury-vapor unit is located above the ceiling level.

A luminaire of different design, combining a straight 400-watt mercury-vapor tube with eight 150-watt incandescent lamps, is a feature of the board of directors' room.

In the two-story public lobby of the new building, where a striking decorative effect rather than high visibility or efficiency was the paramount factor, incandescent cove lighting has been utilized. In the ceiling cove 268 50-watt lamps are employed, and a second cove over the balcony contains 504 25-watt lamps. A third cove beneath the balcony contains 385 25-watt lamps (page 27). This light enters the room through glass filters of a red-orange tint known as "Revelation," which has formerly been confined chiefly to stage lighting. The light harmonizes with the walls and other decorative features, providing a warm tone which offsets any sense of severity in the modern decorative treatment of the room.

From the standpoint of decorative lighting, the exterior panels, 36 ft. high, which have been used to break the windowless exterior of the building also represent an interesting innovation. Almost 1,200 15-watt lamps have been assembled in the three windows behind inner panels of amber diffusion glass flashed with opal. On the outside clear plate glass has been used. The panels provide a contrasting note to the gray of the limestone exterior even during the day, and a striking decorative effect when lighted after dark.

Within the building, in hallways, toilets, small storage rooms, and the like, where units of high wattage are unnecessary, various types of incandescent lighting units ranging from 150 to 500 watts are used. Between hallways and the offices they serve clear glass wall panels have been provided. Consequently, it seemed desirable to light hallways in such a way that there would be no disturbing contrast of straight incandescent light with the "synthetic daylight" in the offices themselves. Domelight fixtures equipped with blue glass below the 150-watt lamp proved satisfactory for this purpose, the improvement in color compensating for the decreased light output which results.

Further evidence of the broad importance which has been attached to better sight as a factor in working efficiency is shown in the lighting now being installed in the printing department, located in the rear section of the new building. This is said to be the largest private printing plant of its type in the country.

More than 188 units of a new design, which combine a straight 30-in. mercury-vapor tube with four 150-watt "Mazda" lamps, are being furnished by the Voigt Company of Philadelphia under license agreement with the General Electric Vapor Lamp Company. These units will also provide a uniform light intensity above 20 foot-candles, with balanced "synthetic daylight" color characteristics achieved by combining a 275-watt mercury-vapor component with 600 watts of incandescent light.

The lighting units are equipped with diffusing glass in an angular relation below the lamps, producing an even distribution and absence of glare and shadow closely approaching the indirect lighting fixtures. Light efficiency of these new units, of which this is the first sizable commercial installation, is considerably improved over former combinations. This combination makes it possible to utilize a new inductively ballasted auxiliary, without hot-wire resistors, so that the 275-watt mercury tube has a light output for which 360 watts was formerly required. A reflector surface of "Alzac" aluminum also contributes to over-all efficiency.

Air-conditioning systems

Two separate air-conditioning systems are being furnished by the York Ice Machinery Corporation, York, Pa. One, already installed, supplies conditioned air to the general offices in the front portion of the building, while the other is to handle the printing department, paper storage rooms, etc., in the rear part of the building, where the Hershey Chocolate labels and cocoa packages are printed.

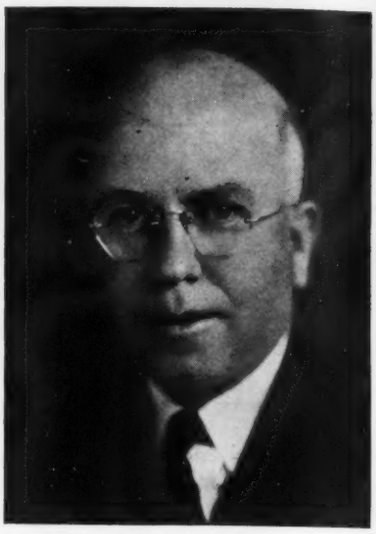
Refrigeration equipment for each of the two conditioning systems is practically identical, consisting of a York 14x10-in., double-cylinder Freon compressor direct connected to a 125-hp. synchronous motor. Each of these will operate in connection with a shell-and-tube condenser 16 ft. long and 38 in.

[*Continued on page 94*]

Credit department in windowless building. Capacity of each lighting unit is 1,050 watts

Facts on Distribution Costs

Examples of Distribution Costs and Their Division—Where Economies May Be Made—No Yardsticks Apply on a General Basis—Suggestions for Analysis and Improvement



By HOWARD P. SEELYE*

Detroit Edison Company

THE cost of distributing electrical power is a subject which is receiving a great amount of attention at the present time. There has been a good deal written on the subject, but it is believed that there are a number of points, and perhaps points of view, which have not been thoroughly covered. Hence, perhaps there is room for one more article on this important topic.

Interest in this subject might be divided into two general classes, typified by the questions

(a) What has distribution cost?
(b) What should distribution cost?

The answers to these may conceivably be quite far apart for some companies and quite close together for others, but this fact is often overlooked. It is true, nevertheless, that there are a good number of companies which have been expending a large amount of engineering effort on their distribution systems for many years past and the art of distribution engineering is not a new and untried field. The practices today on some systems are fully as advanced in distribution as they are on other parts of the property.

The second of these two questions is very difficult to answer concisely. In fact, it is practically impossible to get answers in any but the most general sense. This may be illustrated by Fig. 1, which shows the diversity of replies received from some 30 companies on the cost of their distribution in terms of meters per mile. The costs range from $30 to more than $200 per customer, and probably justly so. It must be recognized that local conditions have a great influence on these costs. Some of these may be enumerated as follows:

Locality—It is much cheaper to build a straight line in sandy soil than a crooked line in rock in mountainous country.

Load Density—The cost per customer may be ten times as high for a few customers along a country road as for a fully built-up city block.

Load Combinations—A system serving a diversified load will naturally have the advantage over one serving only one class.

Design of Lines—Where careful study has been given to distribution engineering the costs may reasonably be expected to be lower than where less attention has been paid to it.

Quality of Service—Duplicate or reserve supply costs money and poor service is naturally cheaper than good service.

A little information on the relative importance of distribution cost might not be out of place. For a fairly large system carrying diversified load the division of investment will probably be somewhat of the order shown in Fig. 2. It is evident that the investment in distribution is somewhere near one-fourth of the total company investment.

If the cost necessary to serve residential customers only is analyzed for the same type of system the result is about as shown in Fig. 3. It is interesting to note that the three divisions, power plant and transmission, distribution and commercial costs are about equal, each about one-third of the total. It is also extremely pertinent to note the very high proportion of the distribution cost which lies in investment charges. Here evidently is a good place to look for economies, if they are to be found—in the investment in distribution.

The statement is frequently made that distribution costs are high, or are too high. A good many of such statements are, of course, not based on any very accurate knowledge of what distribution does cost, and what it should cost. The fact is, and should be clearly recognized, that the cost of distribution must be a fairly high percentage of the total cost of electric service. All we need to do is to consider the cost of distribution of food products, clothing or any other commodities to see that somewhat the same requirements apply to electrical energy. The channels by which that or any other product reaches the distant consumer are devious. That consumer must necessarily pay a large increase over factory production cost for the privilege of having it brought to him in small quantities and at varying distances from the source. The customer who will take a large electrical supply directly from the power house will find his unit cost is probably not over

*Member distribution cost subcommittee, Edison Electric Institute.

one-fourth that for his outlying residence.

The distribution engineer is, for the most part, not so much interested in what his system *has* cost as in what he can do now to reduce the cost in the future. His present practices are partly inherited from the past and partly his own improved ideas. His system is a conglomeration of all the old types of construction and new designs which have been used for the past twenty years or so. The money is spent, the system is operating, and it is out of the question economically to rebuild much of it to any new pattern until it lives out at least most of its life.

The pressing need is to review all these practices in view of modern ideas of distribution design, to see if they are as economical as possible, consistent with the quality of service which it is wished to give, and to see what chances there are to introduce further new economies in future construction.

After ascertaining that the general scheme of distribution is sound and reasonably economical, the first step is to examine the division of cost among the various parts of the construction to see where the money is being spent. Fig. 4 shows a characteristic division between feeders, poles, conductors, transformers, services and meters. A somewhat different division might be found for extreme cases such as farm lines, or very densely loaded lines, but this will serve to illustrate, and is probably near the average. It is evident that poles at 29 per cent are relatively important factors in the cost. Conductors also at 25 per cent are prominent. Transformers at 15 per cent are somewhat less so, but still a good proportion. Feeders at only 5 per cent are relatively unimportant in cost, although sometimes they are given attention all out of proportion. Services and meters loom up rather largely. A recognition of the importance of these various elements now leads to the consideration of what can be done to reduce their costs, especially those of the larger ones.

Prospects for cost reduction

It has been frequently inferred and stated by writers on this subject that revolutionary new developments in distribution design are just around the corner, whereby it will be possible to make major cuts in the costs. Such statements are usually rather vague, but in some cases it has been attempted to prophesy what these changes were to be. At any rate there is not at the present time any new development available, nor does there seem to be any very good prospect of there being any brought out in the near future which will make any such remarkable reductions. Some of the things which have been suggested, primary networks, overhead secondary networks, long-span secondaries, etc., are good in their way and have a place in the general scheme. None of them, however, are of general application and they may very well increase the cost instead of decreasing it, if care is not taken to use them for the particular places for which they are fitted.

On the other hand, the job of reducing distribution costs is really a job of "whittling." We must have poles and wires and transformers, and these must cost a lot of money. By careful attention small amounts may be "whittled" off the cost of many of these items, amounts which are in themselves small and seemingly insignificant, but in the aggregate amount to thousands and perhaps millions of dollars in total system costs. Examples of this will be given later. The wise distribution man will cease dreaming of the invention which will cut the costs 50 per cent and will go to "whittling" on the costs of the items he is now using, being guided by the chipping which others have already done and found practicable.

There are in general two ways to reduce the unit cost of distribution per kilowatt-hour. The first is to increase the load. Of investment in distribution now something like 80 per cent is for "ready-to-serve" facilities, the rest being dependent on the amount of load carried. It is quite evident that the opportunity for making better use of this investment by increasing the load is large. This, however, is largely a commercial problem. The other way is the one already mentioned, reducing the cost of new lines as much as feasible. Some of the ways in which this may be done will be discussed.

Poles constitute about 30 per cent of the distribution investment. One fairly large system has, for example, approximately 400,000 wood poles. Poles are brought according to class or strength. It has been demonstrated that class 5 or even class 6 poles are large enough for a great majority of ordinary distribution lines. For very light loading or for farm lines class 7 has been used successfully. If class 2 or class 3 poles are being used where class 5 or 6 is large enough somewhere around $5 per pole is being invested to no good purpose. By simple arithmetic 400,000 poles at $5 = $2,000,000—a sizable amount.

Use long spans where feasible

Another possible saving in poles is in the use of long spans where they are feasible. On farm lines spans of 400 ft. or more have been found practicable. If, instead, spans of 200 ft. or less are being used without compensating advantages there is a chance of a saving of perhaps $200 per mile. On the other hand, if it is attempted to apply this reasoning to city distribution where services are taken off every 40 ft. or so the extra cost necessary to eliminate the pole may often be

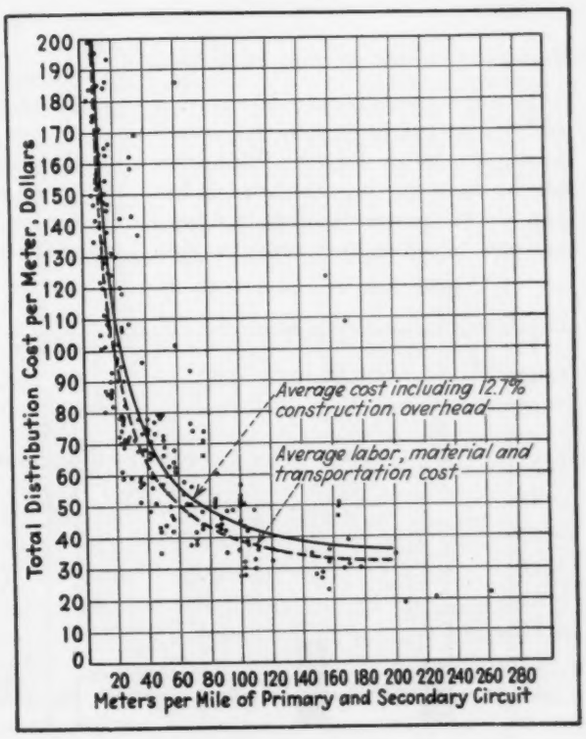


Fig. 1—Total distribution cost varies with meter density

Individual points do not include construction overhead. Note that 53 points are above $200.

more than the cost of the pole itself.

Small economies, such as eliminating the cutting of an unnecessary roof on a pole and using a draw shave to cut gains, while not large in themselves, when applied to several thousand poles per year for a number of years show an aggregate which is worth saving. Treatment of all poles to prolong life is such an obvious economy that it is almost universal, but some companies are still using untreated or poorly treated poles.

Looking at conductors, we find them responsible for about 25 per cent of the cost of residential service. Many companies are using weatherproof wire not only for city lines but in rural territory as well. The cotton and asphalt covering on weatherproof wire constitutes about 30 per cent of its cost in the smaller sizes, somewhere about $30 per mile for No. 6, for example. It represents something like 4 per cent of the total investment in distribution. That is not to say that this is useless investment—far from it. This covering prevents a large number of line outages which would be caused by the surprisingly large amount of foreign material, kite strings, coat hangers, aerial wires, and the like, which are thrown over the lines. On the other hand, in outlying territory, where such troubles are relatively infrequent, real savings by the use of bare wire are possible.

Moderate secondary size advocated

On some systems there has been a tendency to use large wire for secondaries, No. 00 or larger. While this may be necessary in some cases, it has been shown repeatedly that, for general use, to serve load densities now

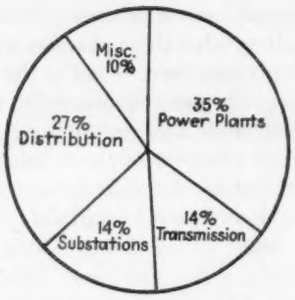


Fig. 2—Distribution of system investment on a large system having a diversified load

common or to be expected for some time to come, No. 4 or No. 2 is more economical. It is not hard to show a difference in total investment of from $50 to $100 per 1,000 ft. of line between an economical design and one which will operate satisfactorily, but which has not been chosen by a study of comparative costs. A square mile of city load will contain something like 18 miles of secondary—50 × 5 × 18 = $4,500. If there are very many square miles this alone would pay for quite a bit of distribution engineering.

Transformers, at 15 per cent of the total distribution cost, present some good possibilities. It is quite common to find transformers loaded well under 50 per cent of their rating, on an average. The difference between 40 per cent loading and 100 per cent loading represents an investment of around $8 to $10 per kva. Naturally, 100 per cent loading is not always attainable on account of diversity of loads, use of standard sizes of transformers, etc. On the other hand, by taking advantage of overload capacity on short peaks, frequent testing to control the loading and banking transformers to distribute the load, an average of over 75 per cent loading and even nearly 100 per cent has been found entirely possible on city circuits. The saving is of the order of $500,000 or more per 100,000 kva. of load.

Recent studies of the effectiveness of using lightning arresters on all distribution transformers and of interconnecting the arrester grounds with the secondary neutrals show quite conclusively the economy possible in saving transformer burnouts. In general, the burnouts are reduced about 50 to 60 per cent when the interconnection is introduced, and even better results have been experienced.

One of the most fertile fields for "whittling" lies in the standardization and simplification of materials. Reduction in the number of items used to a minimum effects savings in purchasing, storing, handling and maintaining which are sometimes hard to compute definitely, but which must be recognized as appreciable. The first work of this kind done at the Detroit Edison Company resulted in cutting the number of items in two. Further reductions were subsequently made. It is also worth while to look for cuts of a few cents in small items which are used in large quantity. A reduction of one cent on an item running into 100,000 per year means $1,000 per year.

Underground lines are often necessary in congested areas and have the advantages of being free from storm troubles and of being out of sight. They are expensive, however, compared with overhead. It is not always realized that the cost of underground

[*Continued on page 96*]

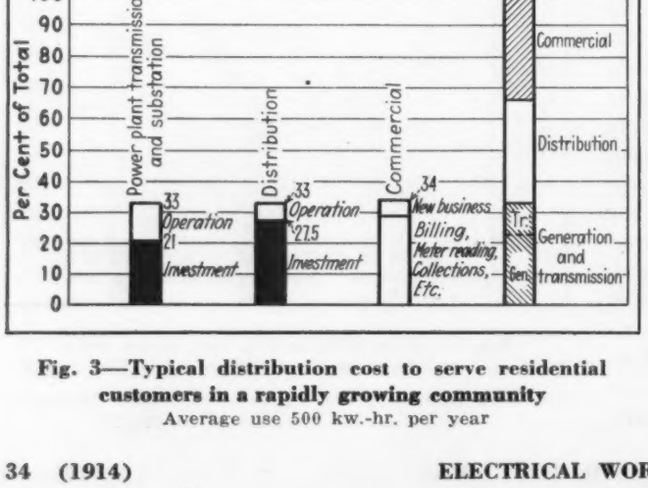


Fig. 3—Typical distribution cost to serve residential customers in a rapidly growing community
Average use 500 kw.-hr. per year

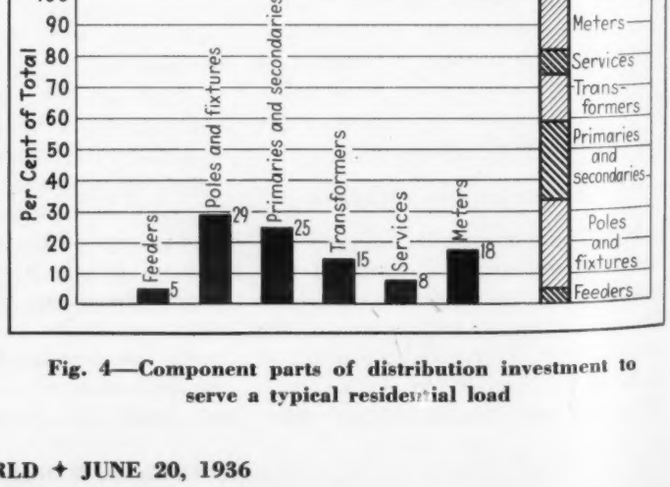


Fig. 4—Component parts of distribution investment to serve a typical residential load

Good Neighbor Rural Policy

Aid Farmers to Understand Their Economics — Engineering Economics Need Study — Operate and Maintain Co-operatives Without Financial Responsibility

By GRAHAM CLAYTOR*
Vice-President American Gas & Electric Company

WE IN the utility industry, more than any one else, have the ability, the experience and the vision to electrify many thousands of farms throughout America which up to the present time have been unable to obtain electric service. At the end of 1923 only 177,561 farms throughout the United States enjoyed electric service, while on January 1, 1936, 788,795 farms were being served. This makes an addition of more than 50,000 farms each year on the average since 1923.

The popular demand for rural electric service is no longer a theory; it's a condition, and the recognition of this fact by those who are logically the ones best qualified to do the job is the first step in solving the problems created by this popular demand. The job requires the best brains of our engineers, economists, manufacturers and salesmen.

The farmer and his income

Of more than half the farms in the nation each produces less than one thousand dollars worth of products annually. Talk to any intelligent industrial power salesman and you will find he has quite a general working knowledge about the business of the concern to which his company supplies power. The business of farming, whether large or small, must also be quite generally understood if we are going to do this job intelligently. The employment of the agricultural engineer is a fine thing and the local manager would do well to familiarize himself with this man's work. The income of practically all farmers is intermittent, seasonal and subject to conditions over which he frequently has no control.

Vast numbers of families living on small farms, whether owner or tenant, are more concerned with where the next sack of flour or side of bacon is coming from than whether or not they can obtain electric service; nevertheless, be that farmer the owner of many fertile acres or the tenant of some humble cottage he is being told daily through the papers, over the air and at the crossroads community meeting that the day of electric service for everybody, everywhere is about to arrive. We know that this is not true and that many farmers are being jollied for reasons too obvious to mention.

I think we should extend our service to every farmer in the territory we serve within the bounds of reason, but we should not let our salesmen, in their natural enthusiasm, try to persuade the farmer to assume obligations which our economic studies show he is utterly incapable of performing. Don't forget that the average farmer has plenty of horse sense. We shall cooperate with him and be a good neighbor, but we shall tell him the facts, and in most cases we shall make a friend.

Engineering aspects

The problem of voltage regulation on rural lines requires serious study. Although it is expensive to reach them, rural customers expect, and we must be prepared to give them, as good a quality of service as their urban neighbors receive. Such lines often extend over considerable distances, and even though they may be lightly loaded, they may have poor voltage regulation. To make possible the correction of such conditions under the limited revenue that most rural lines yield, our company has co-operated with one of the manufacturers in the development of an automatic step-type regulator. This unit, all self-contained, can now be purchased for approximately 50 per cent of the cost of the conventional induction regulator.

Further studies of the use of bare neutral is most important not only in wiring of the house and barn but for use on services, secondaries and even on primaries with an interconnection primary secondary neutral. A recent agreement with the Bell companies permitting multiple grounding is a long step in this direction.

Policy with the co-operatives

Regardless of what we think about our ability to furnish the most economical, efficient and safest service, and in spite of any efforts, no matter how intensive, to build thousands of miles of rural lines, we are going to have the co-operative; first, because there have been cases where we have fallen down on the job; second, there are people who sincerely believe that the co-operative is the only solution, and no amount of facts or arguments presented to them will change their opinion; third, politics in one form or another will be responsible for the creation of some co-operatives.

Admitting these facts, what are we

*Abstract of paper presented at Southeastern Electric Exchange.

going to do about it? I should like it understood that what I have to say about this problem (and I think it is the most serious one we have confronting us) are my own personal views and not those of any group or association, nor are they to be construed as expressing any company policy.

I believe it is our duty to give those promoting such organizations all of the facts and reasons why we should do the job, if it is to be done. If we cannot succeed in this and it is a fact that they can do the job better than we can, then they should do it with no opposition from us but with our wholehearted support.

If it be true that some utilities are trying to block the co-operative, as they are accused of doing, by building into a given community line, which supply primarily the most profitable section and leave the rest without service, then I say we are making a mistake and will suffer for it in the long run. If we are unwilling or cannot perform what the co-operative can do and do it better, then I say stay out of that community and let the other fellow alone.

The co-operative that comes into being must have a source of electric power. We are the logical ones to supply it. I think the utilities in each state should get together with the state commission and farm organizations and work out and put into effect a uniform wholesale rate for co-operatives. At present each company has its own pet tariffs and frequently "views with alarm" the filing of another rate. I am sure some of you will have weighty arguments about discrimination and what not, but I have had enough experience with rate matters to convince me that it can and should be done.

Service and the co-operative

The co-operative, having organized, obtained the necessary loan, constructed the lines, contracted with the utility for power, starts in the business of supplying rural electric service. It will not be so simple as it sounds. We know that this is a highly technical business, and it is not reasonable to think a group of farmers can afford to have an organization of engineers, linemen, repair crew, etc., which the utilities have, and find essential, in order to render the service their customers expect and demand; engineering problems involved in extensions, proper distribution of loads, voltage regulation, telephone interference, and numerous other questions they will have to solve. Now, our problem is: What are we going to do about it?

It seems to me there are three ways the utilities can handle this situation:

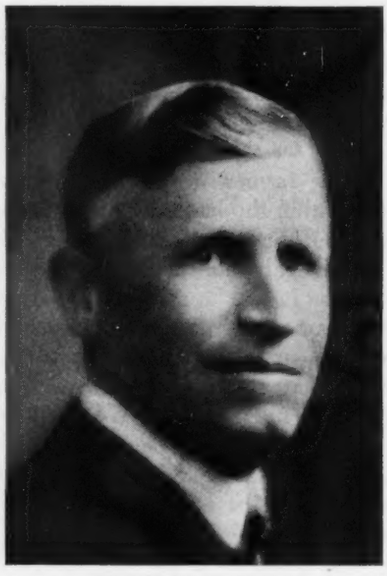
1. Do nothing, by taking the attitude that the co-operative is not of our creation, and let those responsible for it stew in their own fat. I don't think any one can convince me that such a policy is the correct one.

2. Adopt the same attitude toward the co-operative as we do toward other wholesale or industrial customers—help them with their engineering problems, their sales of appliances, and in numerous other ways, such as sending our repair crew to help out in case of storms or other emergency; in short, show them that the utilities can be a good neighbor. I am in favor of such a policy.

3. Make a fair service contract to operate and maintain the lines, read meters and bill the customers; in fact, relieve them of all responsibility except the investment. This last method may be difficult to work out to begin with, but I believe eventually it can be done with satisfactory results to both the farmer and the utility and will come about as a natural result, if the utilities adopt this "good neighbor" policy.

Bauer on the Responsibilities of a Utility Employee

. . . It is not sufficient to furnish electrical service—it must be furnished at the lowest possible rates and it must be *good* service. All of the millions which have been spent to render service to a customer will have been spent in vain, in so far as rendering *good* service is concerned, unless the individual employees, particularly those in so-called subordinate positions, realize the responsibility of their jobs. So far as the good will of one customer is concerned, all that has been built up during years of painstaking effort may be lost in an instant by the failure of one employee to realize the proper performance of his job was necessary in order that all which had theretofore been done to provide this customer with good service might not be idle and useless expenditure . . . The "man in the ranks" is likely to regard himself as just a cog in a great machine, but he is



no different than any other employee of the company up to and including the president—we are all cogs in the machine . . . and in the ultimate analysis the final step in the company's efforts to render *good* service is the responsibility of the private in the ranks. It is his obligation and his responsibility to be sure that his attitude toward his job and his actions to the customer reflect at all times the company's eagerness and willingness to serve the public well . . . In all of the thousands of jobs in a utility there is not one that is unimportant . . . All are equally important in that the failure of performance of one may ruin all . . . Our opportunity for serving humanity carries with it the responsibility of rendering good service if this business is to continue to merit the wholesome public respect that it now enjoys.

HARRY J. BAUER,
President Southern California Edison Co., Ltd.

Aerial Survey Aids Electrification Project

AERIAL survey played an important rôle in enabling the Hydro-Electric Commission of the State of Oregon quickly to project an electrical distribution system throughout Polk County, in the northwestern part of the state. During four flights, embracing only fourteen hours of flying, 410 square miles of territory were accurately photographed at a cost, excluding Hydro-Electric Commission salaries, of less than $55,000. A ground survey of the same area would have taken months or years, depending upon the size of the force employed, but the maps so secured would not have included the complete detail which is a feature of the aerial photographs.

Without having to make extended personal visits to isolated back-country roads, the engineer is able to draw up a report while sitting at his desk with a photograph before him. Furthermore, it is possible to project the system with due regard to the timbered and cultivated areas, streams, roads and highways, and even to estimate with some degree of accuracy the amount of clearing or tree trimming required and many other details of the lines themselves, such as the guys and dead-ends needed, the most efficient location of transformers and of primary and secondary spans. A vast amount of detail work required for preliminary surveys is now done by means of pictures without having to leave the engineering quarters.

The photographs were assembled into mosaics on beaverboard measuring 3x2 ft., a convenient size for handling and for filing. The boards can be quickly assembled into a mosaic depicting the entire area. When assembled, the mosaic measures 10 ft. square.

Cost and the labor involved in making this survey were cut somewhat by reducing the amount of overlap. For the purposes of the Oregon commission overlaps of 20 per cent in line of flight and 25 per cent in parallel strips, instead of the usual 60 and 40 per cent, respectively, were sufficient. The aerial camera used has an F4.5 lens and 12-in. focal length; it was flown at 14,000 ft. along lanes up to 25 miles long and 1½ miles apart. The film was 75 ft. long and 9 in. wide, sufficient for 100 exposures. Because of the prevalence of haze and smoke filters were used constantly.

Flying and photography were done in a Fairchild photographic plane owned by the Eyerly Aircraft Corporation of Salem, Ore., under the general direction of L. A. Stanley, engineer for the Oregon Hydro-Electric Commission; W. S. Hazelwood of the Eyerly Corporation was the pilot; John Gearhart the photographer. The scale of the pictures is 1,170 ft. per inch. A total of 310 photographs were secured in the survey.

Aerial survey aids electrification project

Upon this aerial photograph the engineer has indicated pole locations, guys, transformers, primary spans, secondary and individual customer classifications. Various other supplementary uses by operating companies suggest themselves. For example, utility storekeepers could use the photograph to check material lists and line truck supplies. Sales departments could confirm revenue estimates and suggest revisions in engineers' plans to improve capital-revenue ratios. Treasurers and budget committees would be enabled to approve or reject projects with a picture of the actual situation before them. Discussions with governmental representatives, often held many miles away from the scene of operations, would be simplified. The photograph could be filed in place of present distribution maps.

The Nation's Power Supply

Analysis Shows Transmission of Remote Hydro Power Costlier Than Coal Haul

Production costs are compared of a modern steam plant at the mine mouth and of a hydro plant. Transmission of electrical energy is found to be more costly than the hauling of equivalent coal, making it more economical, under conditions frequently encountered, to generate power near the load from fuel than to supply it from a distant water-power development. Construction by the government of uneconomic and misplaced power developments is an inexcusable waste of public money. Federal competition with private industry threatens to destroy their prosperity, promote unemployment and ultimately ruin thousands of innocent investors.

By FRANK F. FOWLE*

President Western Society of Engineers, Consulting Engineer, Chicago

POWER developments in the United States amount to approximately 51,000,000 kw., of which 36,000,000 kw. is in public utility plants, including municipal enterprises, and 15,100,000 kw. in industrial plants. About 2,000,000 kw. is in municipal establishments. Hydro plants comprise 11,200,000 kw.

Prior to 1933 we might have said, without many exceptions, that the choices of locations for this 51,000,000 kw. of capacity were either at the market, or nearby, or within economical transmission distance, when the choices were made. Since 1933, however, it has been proposed, chiefly in Congress and among public officials, to embark on the development of water power on a scale of heretofore unknown magnitude. Therefore unusual interest centers today on the fundamental problems pertaining to the economical selection of power sites with reference to the location of markets, fuel supplies and water power and on the allied problems of transmission and distribution. Fundamental to the whole question, of course, are the magnitude and distribution of power markets from a national viewpoint.

A complete electric utility of average size requires at present an investment on the order of $365 per kilowatt of installed capacity, or $520 per customer served. Approximately 38 per cent of this amount is invested in generating plant, 24 per cent in transmission lines and 38 per cent in local distribution systems. These three classes of plant serve basically different purposes in supplying power to the ultimate consumer. The function of the generating plant is to produce power and deliver it to the station "door." Transmission lines are exclusively for the bulk transmission of power from the generating stations to the market centers of distribution. Distribution systems are comprised of the substations, supply feeders, primary mains, distribution transformers, secondary mains, service drops and meters which distribute power to the ultimate consumers within local market areas.

This utility plant as a whole has an average physical life on the order of 25 to 30 years. The annual charges for interest, taxes, insurance and depreciation on the investment constituted in 1935 about 65 per cent of the whole cost of service. If for any reason the economic life of this plant is materially less than the physical life, the cost of service will be thereby increased, perhaps seriously. *It is therefore highly essential that utility plants be not only well designed, but also properly located with respect to their markets,* so that serious errors in location or capacity will not arise to shorten the economic life and increase the cost of service.

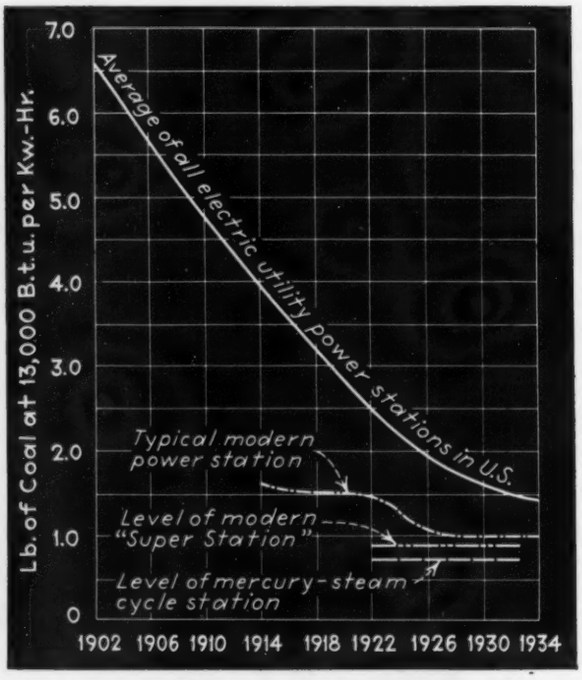


Fig. 1 — Trend in fuel consumption of steam generating plants in the United States, 1902-1934

About a year ago the Federal Power Commission published a report entitled "National Power Survey" with the subtitle "Interim Report, Power Series No. 1." This report is in large part a national census of the electric utility development as it existed at the close

*Abstracted from a paper presented at the recent Midwest Power Engineering Conference.

Table I—Summary of Population, Annual Fuel Production and Estimated Average Annual Output of Undeveloped Water Power in the Continental United States

Zone	Region	Population Total (1930)	Population Per Cent of Tota	Fuel Production* Total Tons J929)	Fuel Production* Per Cent of Total	Undeveloped Hydro (1934) Thousand Kilowatt-Hours	Undeveloped Hydro (1934) Per Cent of Total
1	Northeast	32,835,114	26.8	3,840,000	0.4	21,075,000	7.6
2	Middle West	39,639,401	32.3	491,770,000	52.5	13,203,000	4.8
4	Mountain and Plain	6,431,618	5.2	45,607,000	4.9	15,992,000	5.8
5	Southwest	12,600,147	10.2	203,100,000	21.7	6,301,000	2.3
	Sub Total	91,506,280	74.5	744,317,000	79.5	56,571,000	20.5
3	Southeast	21,594,823	17.6	99,791,000	10.6	41,112,000	14.9
6	Pacific Northwest	2,962,214	2.4	2,520,000	0.3	114,200,000	41.5
7	Pacific Southwest	6,711,729	5.5	90,700,000	9.6	63,800,000	23.1
	Sub Total	31,268,766	25.5	193,011,000	20.5	219,112,000	79.5
	Total U. S. A.	122,775,046	100.0	937,328,000	100.0	275,683,000	100.0

*Coal, Oil and Gas expressed in terms of Coal Equivalent.

of 1934. In the zones comprising the northeastern and central areas the ratio of undeveloped water power to population and fuel production is a minimum (Table I). These zones embrace 75 per cent of the population, 80 per cent of the fuel production and 20 per cent of the undeveloped water power. The remaining zones comprise the Southeast and the far West. They contain 25 per cent of the population, 20 per cent of the fuel production and 80 per cent of the undeveloped water power. It is interesting to note that 42 per cent of the undeveloped water power is in one zone, the Pacific Northwest, which comprises only 2.4 per cent of the population.

The Federal Power Survey takes no account of 15,000,000 kw. of generating capacity in private industrial plants, or upward of 17,000,000 kw. of installed motor capacity in those plants, operated with purchased power. Wholesale consumers of electric power used in 1935 a total of 60 per cent of all power sold to ultimate consumers. The geographical distribution of this large industrial use is highly significant to all other classes of consumers, because it makes the total national generation about two and one-half times as large as it would be otherwise and thereby lowers the unit cost of generation and transmission to all consumers, even the smallest. Furthermore, some industries purchase steam from utilities and sell power to them. Therefore it seems like a rather serious omission to leave this industrial situation out of consideration in presenting a survey or census of the national power picture.

There is no national shortage of power today and no sound reasons can be found to expect one in the future, barring a war emergency and its abnormal demands. The only classes of potential consumers still without electric service are those in rural districts, and this situation will be reviewed under a subsequent heading.

Survey of resources and capacity

For the country as a whole there is 8.7 times as much water power undeveloped as there is now in use, expressed in terms of output. In the group of zones having abundant water power the latter ratio rises to 12.8 and for the Pacific Northwest it is 32.4. *If this undeveloped water power were within economical transmission distance of important power markets, these figures would be rather reassuring, but, unfortunately, such is not the fact, except perhaps in the Pacific Northwest.*

Coal is found in mineable quantities in 31 states and the reserves are estimated at more than 3,000 billion tons, of which only 25 billion tons have been mined. At the 1929 rate of consumption (for all purposes) of about 600 million tons per year there is obviously no occasion to be concerned about possible exhaustion for hundreds of years to come. Moreover, *the important fuel reserves are within reasonable transportation distance of the chief power markets of the country.* Oil and gas fields, in addition to coal, are widely distributed.

Tables II and III show the ages of generating equipment and the trend toward larger units. Generating efficiencies of steam units at 60 per cent load are summarized in Table IV. Practically one-half of the total output in 1934 was produced with an average efficiency of about 16,000 B.t.u. per kilowatt-hour (range 14,000 to 18,000) and 28 per cent of the output was produced at less than 14,000.

The average percentage of dependable generating capacity in ratio to installed capacity is shown in Table V. For steam generation the ratio varies but little in different zones and averages 95 per cent. For hydro generation the ratio varies from 54 per cent in zone 2 (Middle West) to 85 per cent in zone 5 (Southwest), with a national average of 65.5 per cent. Naturally the latter figure will be lower in dry years.

Comparative costs of generation

For purposes of comparison the cost of energy generation by steam and by hydro has been estimated under the assumption of 100 per cent capacity factor and 50 per cent load factor in both instances. A plant cost of $85 per kilowatt has been assumed for steam as representative of the run of

Table II—Total Generating Capacity in Service in 1934

(Federal Power Survey)

Period of Installation	Capacity in Kilowatts Steam	Hydro	Int. Comb.	Grand Total
Prior to 1901	19,498	27,700	.....	47,198
1901–05	76,788	170,064	.....	246,852
1906–10	614,587	627,215	348	1,242,150
1911–15	1,823,399	1,225,450	3,843	3,052,692
1916–20	3,734,937	1,021,115	3,914	4,759,966
1921–25	6,476,040	2,228,249	11,672	8,715,961
1926–30	7,851,200	2,591,101	47,972	10,490,273
1931–34	1,447,750	662,880	37,242	2,147,872
Total	22,044,199	8,553,774	104,991	30,702,964
Date not stated*	407,861	431,033	46,328	885,222
Total U. S. A.	22,452,060	8,984,807	151 319	31,588,186

*Steam and hydro plants of less than 2,500 kw. and internal-combustion plants of less than 500 kw.

Table III—Steam Plant Capacity in the U.S.A. Classified According to Age and Size of Units

(Federal Power Survey)

Period of Installation	Under 10,000 Kw.	10,000 to 30,000 Kw.	Over 30,000 Kw.	Total Kw.
Prior to 1901	20,000	.....	.....	20,000
1901–10	311,000	326,000	54,000	691,000
1911–25	2,352,000	6,888,000	2,809,000	12,034,000
1026–34	474,000	2,754,000	6,056,000	9,299,000
Total	3,157,000	9,968,000	8,919,000	22,044,000
Unclassified*	.....	.....	.....	408,000
Total U. S. A.	.....	.....	.....	22,452,000

*Plants less than 2,500 kw.

Table IV—Steam Plant Capacity in the U.S.A. Classified According to Efficiency at 60 per Cent Load

(Federal Power Survey)

Production Efficiency: B.t.u. per Kw.-Hr.	Plant Capacity: Kilowatts	Per Cent of Total	Plant Output: Thousands of Kilowatt-Hours	Per Cent of Total
Under 14,000	4,132,000	18.7	12,397,000	28.3
14,000 to 18,000	8,592,000	38.9	20,901,000	47.8
18,000 to 22,000	4,368,000	19.7	6,549,000	15.0
22,000 to 25,000	2,410,000	10.9	2,086,000	4.8
25,000 to 30,000	1,539,000	7.0	1,341,000	3.1
Over 30,000	1,045,000	4.7	416,000	1.0
Total*	22,086,000	100.0	43,690,000	100.0

*Plants less than 2,500 kw. excluded.

Table V—Installed and Dependable Generating Capacity of Major Electric Utilities

(Federal Power Survey)

Zone	Region	Generating Capacity: Kw. Fuel	Kw. Hydro	Per Cent Dependable Fuel	Hydro
1	Northeast	8,001,000	2,426,000	94.8	74.3
2	Middle West	9,321,000	1,095,000	94.0	54.0
3	Southeast	1,521,000	2,099,000	96.2	57.8
4	Mountain and Plain	499,000	344,000	99.5	80.0
5	Southwest	1,672,000	93,000	97.0	85.0
6	Pacific Northwest	393,000	1,183,000	94.5	80.4
7	Pacific Southwest	1,193,000	1,745,000	93.5	55.8
	Total U.S.A.	22,603,000	8,985,000	94.7	65.5

the best modern plants now in service. A cost of $250 per kilowatt of firm hydro capacity is representative of the less costly hydro projects undertaken by the federal government, as will be shown later. No credit is given the hydro plant for secondary power because it has been assumed that there is no steam reserve. Fixed charges on the investment have been assumed at 12.5 per cent per annum on the steam plant and 10.5 per cent on the hydro plant.

The location of the steam plant has been assumed at the mine mouth, with 11,000 B.t.u. coal costing $1.60 per ton delivered to the plant. A generating efficiency of 13,000 B.t.u. per kilowatt-hour, or 1.18 lb. of coal, has been assumed as fairly representative of the best modern plants now in service. This figure of about 1.2 lb. of coal per kilowatt-hour compares with about 1.4 lb. as the average of commercial utility plants in 1934. The historical trend for all utility plants is shown in Fig. 1. Steam plant costs may be expected to trend downward in the future, and efficiencies upward, but future trends have been disregarded in this comparison. The results are summarized in Table VI.

The result for the steam plant is a total cost of 4 mills per kilowatt-hour at the plant bus, compared with 6.3 mills at the bus of the hydro plant. These costs include all fixed charges and operating expenses. When the cost of the hydro plant is materially less than $250 per kilowatt of firm capacity, or a material portion of the cost is allocated to other benefits, as flood control or navigation, the cost of hydro power may be as low as the cost of steam power or even less. Moreover, when the hydro plant is co-ordinated with a steam plant, so that secondary hydro power can be generated, the benefits will be reflected in larger total hydro output and lower unit cost per kilowatt-hour. On the other hand, the example selected above does not penalize the hydro plant for restricted output in dry years, although it might be contended that this consideration ought to be given proper weight in arriving at the true cost of power. If it were, the cost of firm hydro power would be somewhat higher on the average than the figure arrived at.

The foregoing comparison, based on a steam plant at the mine mouth and a hydro plant at the water-power site, has been selected to show the costs of power generation exclusive of transmission. These generation costs have later been combined with transmission costs, in various ways, to show the total cost of power delivered to a hypothetical market center under several typical conditions.

Power transmission, wire versus rail

The Census for 1932 listed about 251,000 transmission circuit miles at voltages from 6.6 to 220 kv. The 270-mile, 285-kv. Boulder Dam line has been built since that date.

Technical progress in electric transmission is so fully covered in the technical press and the transactions of the leading engineering societies that it is not advisable to attempt a summary of it in this paper. Attention will be directed instead to the economics of transmission, in order to focus attention on the probable future trend of commercial development under the present state of the art.

Three typical examples of transmission have been selected for consideration; these are summarized directly below:

Table VI — Comparison of Generating Costs: Steam Plant at Mine Mouth Versus Hydro Plant at Water Site

	Steam Plant Located at Mine Mouth	Hydro Plant Located at Water Site: Installation equal to Firm Capacity
Total installed capacity (Kw.)	100,000	100,000
Cost per kilowatt of installed capacity	$85	$250
Total cost of plant	$8,500,000	$25,000,000
Annual load factor (per cent)	50	50
Annual output, kilowatt-hours	438,000,000	438,000,000
Annual fixed charges (per cent)	12.5	10.5
Annual fixed charges (dollars)	$1,063,000	$2,625,000
Pounds of coal per kilowatt-hour*	1.18	.....
Annual coal consumption (tons)	259,000	.....
Annual cost of coal at $1.60 per ton	$414,000	.....
Operating supervision, labor and repairs†	$263,000	$131,000
Total annual cost (dollars)	$1,740,000	$2,756,000
Cost per Kilowatt-hour (mills)	3.97	6.30
Recapitulation:		
Fixed production costs: mills per kw.-hr.	2.43	6.00
Variable production costs: mills per kw.-hr	1.54	0.30
Total production costs: mills per kw.-hr.	3.97	6.30

*Based on plant efficiency of 13,000 B.t.u. per kilowatt-hour and heating value of 11,000 B.t.u. per pound of coal.

†Estimated at 0.6 mills per kilowatt-hour for steam plant and 0.3 mills for hydro plant.

Distance Miles	Voltage Kv.	Circuits	Circuits per Structure	Total Power Delivered Kw.	Cost per Mile
50	66	2	2	50,000	$13,000
100	132	2	2	120,000	22,000
200	220	2	1	300,000	50,000

In addition to annual charges at 12.5 per cent on the investment in the line itself, the total cost of transmission includes three additional items: (1) Fixed charges on the terminal substations at 12.5 per cent; (2) fixed charges on approximately 11 per cent of additional capacity of generating plant to offset 10 per cent transmission loss; (3) annual cost of energy losses in transmission. The cost of terminal substations has been estimated at $8 per kilowatt for 66 kv., $10 per kw. for 132 kv., and the latter plus synchronous condensers for 220 kv. The cost of energy losses in the system has been assumed as 5 mills per kilowatt-hour. The details of these costs are assembled in Table VII. There it is shown that the total cost of transmission, based on 100 per cent capacity

Table VII—Cost of Electric Transmission Compared with Cost of Transportation of Coal for Equivalent Generation

	200 Miles at 220 Kv. Twin Circuit	100 Miles at 132 Kv. Twin Circuit	50 Miles at 66 Kv. Twin Circuit
Rated output per circuit (kw.)	150,000	60,000	25,000
Total capacity, two circuits (kw.)	300,000	120,000	50,000
Annual load factor	50%	50%	50%
Annual Transmission efficiency	90%	90%	90%
Annual input, kilowatt-hours	1,460,000,000	584,400,000	243,300,000
Annual output, kilowatt-hours	1,314,000,000	526,000,000	219,000,000
Transmission loss, kilowatt-hours	146,000,000	58,400,000	24,300,000
Cost of complete line, per mile	$50,000	$22,000	$13,000
Total cost of line	$10,000,000	$2,200,000	$650,000
Cost of two complete terminals	$6,750,000	$2,400,000	$800,000
Total cost of transmission system	$16,750,000	$4,600,000	$1,450,000
Annual charges at 12.5 per cent	$2,094,000	$575,000	$181,000
Additional capacity of generating plant required to compensate for line loss (kw.)	33,300	13,333	5,550
Cost of additional plant capacity @ $85 per kw.	$2,830,000	$1,139,000	$472,000
Annual charges at 12.5 per cent	$354,000	$141,000	$59,000
Cost of annual transmission loss at 5 mills per kilowatt-hour	$730,000	$292,000	$121,000
Recapitulation:			
Annual charges on transmission system	$2,094,000	$575,000	$181,000
Annual charges on additional generating plant	$354,000	$141,000	$59,000
Annual cost of energy losses	$730,000	$292,000	$121,000
Total annual cost	$3,178,000	$1,008,000	$361,000
Total transmission cost, mills per kw.-hr.	2.42	1.92	1.65
Tons of coal required to generate output of transmission line, at 1.18 pounds per kilowatt-hour	775,000	310,000	129,200
Freight charge per ton for transporting coal by rail for same distance that Power is transmitted*	$1.60	$1.25	$1.08
Total cost of freight on coal	$1,240,000	$388,000	$140,000
Freight cost, mills per kw.-hr	0.94	0.74	0.64
Saving by transporting coal (Total)	$1,938,000	$620,000	$221,000
Saving per kilowatt-hour (mills)	1.48	1.18	1.01
Tons of coal on which the total freight would be the same as the total annual cost of transmission	1,986,000	806,400	334,300
Total heat in coal, millions of B.t.u.†	43,690,000	17,740,000	7,355,000
B.t.u. per kilowatt-hour of above output	33,200	33,700	33,600
B.t.u. per kw.-hr., modern steam station	13,000	13,000	13,000

*Freight rate per ton of coal equals $0.90 plus 3.5 mils per mile; applicable to Middle West.
†At 11,000 B.t.u. per pound of coal or 22 million B.t.u. per ton.

factor, 50 per cent annual load factor and 10 per cent energy loss in the line and terminals, is as follows:

50 miles at 66 kv.....1.65 mills/kw.-hr.
100 miles at 132 kv.....1.92 mills/kw.-hr.
200 miles at 220 kv.....2.42 mills/kw.-hr.

In economic contrast with this method of transmitting power there is the alternative of transporting the equivalent fuel by rail. The cost of transmission by the latter method will consist of the freight charges on the equivalent coal required to generate the same output in a modern steam plant. Coal consumption has been estimated at 1.18 lb. per kw.-hr., based on 13,000 B.t.u. per kw.-hr. and 11,000 B.t.u. per lb. of coal.

At the Chicago meeting held on January 31, 1935, before mentioned, W. L. Abbott presented the following formula for the freight rate per ton of coal under conditions typical of the Midwest:

Rate per ton = $0.90 plus 3.5 mills per mile.

At this freight rate the cost of transporting the equivalent coal for the same annual output indicated above will be:

50 miles.....0.64 mill/kw.-hr.
100 miles.....0.74 mill/kw.-hr.
200 miles.....0.94 mill/kw.-hr.

If, on the other hand, it be assumed that the total tonnage of coal transported be increased until the total freight charges are equal to the annual cost of electric transmission, it will be found that if this tonnage of coal were all required to generate electrical energy in a steam plant, the resultant economy would be about 33,000 B.t.u. per kw.-hr., or corresponding to about the poorest of steam plants still in service (see Table IV).

These results are all summarized for comparison in Table VIII. *The cost of electric transmission is 2.6 times the cost of transmission by rail,* as shown by comparisons covering ranges of distance from 50 miles to 200 miles. Stated in another way, if the efficiency of generation in a steam plant were so low that the costs of transmitting power by wire and by rail were equal, the steam plant would rank among the poorest one per cent of all steam generating stations in service in 1934. Or, stated still differently, if it were necessary to haul coal by rail so far that the costs of transmission by the two methods were equal, the comparison of distances would be as follows:

Electric Transmission	Rail Transmission	Ratio Rail to Wire
50 miles	540 miles	10.8
100 miles	670 miles	6.7
200 miles	915 miles	4.6

Putting these results in simple terms, they show that when a hydro plant is 50 miles from the market it will cost no more for transmission when coal is hauled 540 miles, or eleven times as far. When a hydro plant is 100 miles from the market it will cost no more for transmission when coal is hauled 670 miles, or almost seven times as far. When hydro is 200 miles from market it will cost no more to haul coal 915 miles, or almost five times as far.

Naturally these comparisons assume

Table VIII—Unit Cost of Electric Transmission Compared with Cost of Transportation of Coal for Equivalent Generation

	200 Miles at 220 Kv. Twin Circuit	100 Miles at 132 Kv. Twin Circuit	50 Miles at 66 Kv. Twin Circuit
Total delivery capacity (kw.)	300,000	120,000	50,000
Annual load factor (per cent)	50	50	50
Annual output, million kilowatt-hours	1,314	526	219
Cost of delivered energy, mils per kw.-hr:			
Annual charges on Transmission system	1.59	1.09	0.83
Annual charges on additional generating plant	0.27	0.27	0.27
Annual cost of energy losses in system	0.56	0.56	0.55
Total transmission cost.	2.42	1.92	1.65
Cost of freight haul on equivalent coal	0.94	0.74	0.64
Saving over transmission (per cent)	158	159	158
B.t.u. per kilowatt-hour at equal cost	33,200	33,700	33 600

Table IX—Summary of Cost of Steam Generation Plus Transmission

(Mills per Kilowatt-hour)

	200 Miles	100 Miles	50 Miles
Generation	3.97	3.97	3.97
Transmission	2.42	1.92	1.65
Total	6.39	5.89	5.62
Efficiency of steam Generation without Transmission, at equal total cost:			
B.t.u. per kw.-hr.	33,200	33,700	33,600

that the formula for the freight rate given above will hold for relatively long distances, but whether it does or not is unimportant here. The outstanding fact is that electric transmission is uneconomic in comparison with rail transport of coal to a modern steam plant, under conditions typical of the Midwest as to freight rates for at least 200 miles. The general consequences of combining these transmission costs with the preceding generation costs will be considered under a subsequent heading.

Electrical distribution

In 1935 the total investment in all electric utility systems was about $13,100,000,000, of which approximately 38 per cent was for generating plant, 24 per cent for transmission and 38 per cent for distribution plant. Based on certain specified assumptions as to the proportionate output from fuel and from water power, efficiency of steam plants, cost of fuel and return on the investment it is shown that the average cost per kilowatt-hour delivered at wholesale was approximately 1.25 cents and the cost at retail 4.3 cents. The latter checks reasonably well with published figures for average revenue at retail for commercial and domestic sales.

The possibility of competition in supplying local markets, in consequence of the development of so much power by federal and other projects now under construction, is something which merits discussion. On the average the cost of distribution comprises about 70 per cent of the cost of service to retail customers and 65 per cent of the cost of service is comprised of annual charges on the investment. Duplicate facilities on the streets are objectionable; idle plant, divided patronage and rate cutting are likely to bring financial disaster. Local competition appears to be undesirable from about every standpoint, including the helpless investors who may be ruined by it.

Rural distribution

It is difficult at best to render self-supporting rural service at a cost which prospective customers are willing or able to pay for it. The relatively low development is due in large part to the economic resistance represented by the preliminary investment in interior wiring, lighting fixtures, lamps and appliances. Another factor retarding development has been the commercial risk in building long rural lines into thinly populated districts. On the other hand, the economic benefits of rural service are constantly attracting new customers, and at present this class of development is growing quite rapidly.

The utopian ideal of electric service lines to every farm and home in the land is undoubtedly impossible of realization, except on the basis of a heavy government subsidy at the expense of the taxpayers nationally. Moreover, it would be uneconomic in any event.

In the event that Congress should appropriate one billon dollars for rural electrification, as recently proposed, it would be more economical in many cases to *subsidize the purchase of individual farm-generating plants* than to build rural supply lines.

Power system design

Problems of system planning which transcend those of local distribution are concerned with delivering bulk power supplies to the market centers. These problems involve the difficult question of where and how to produce power the cheapest, when the costs of generation and transmission are both taken into account. Suitable sites for modern steam plants require very large water supply for condenser circulation and ample facilities for receiving and storing large quantities of fuel. Water power sites may also be available within the limiting distances considered feasible for transmission.

Many aspects of this major subject might profitably be selected for discussion, but probably the topic of greatest current interest is the comparative economy of steam and water power when fuel sources and hydro sites are both distant from market centers.

For convenience, the results of previous estimates of the cost of steam power at the mine mouth and the cost of transmission are assembled in Table IX. For comparison, the costs of steam power generated at the market, with fuel hauled various distances by rail are assembled in Table X. As previously emphasized, the latter costs are the lower of the two. That is to say, *it is cheaper to transmit power in a coal car than by wire.*

Table X—Summary of Cost of Steam Generation Plus Freight Haul on Coal

	300 Miles	200 Miles	100 Miles	50 Miles
Freight rate per ton.....	$1.95	$1.65	$1.25	$1.08
Kilowatt-hours per ton...	1,692	1,692	1,692	1,692
Freight: mills per kw.-hr.	1.15	0.94	0.74	0.64
Generation: mills per kw.-hr.....	3.97	3.97	3.97	3.97
Total cost per kw.-hr..	5.12	4.91	4.71	4.61

Table XI—Cost of Hydro Generation: With Various Plant Costs

(Cost Per Kw. of Firm Capacity)

	$125 Per Kw.	$105 Per Kw.	$85 Per Kw.	$65 Per Kw.	$45 Per Kw.
Installed capacity: kw.....	100,000	100,000	100,000	100,000	100,000
Cost per kw.....	$125	$105	$85	$65	$45
Total cost.....	$12,500,000	$10,500,000	$8,500,000	$6,500,000	$4,500,000
Annual load factor %.....	50	50	50	50	50
Annual output: Kw.-hr.....	438,000,000	438,000,000	438,000,000	438,000,000	438,000,000
Annual fixed charges, %.....	10.5	10.5	10.5	10.5	10.5
Annual fixed charges.....	$1,313,000	$1,103,000	$893,000	$683,000	$473,000
Supervision, labor & repairs.....	$131,000	$131,000	$131,000	$131,000	$131,000
Total annual cost.....	$1,444,000	$1,234,000	$1,024,000	$814,000	$604,000
Cost per kw.-hr., mils.....	3.30	2.82	2.34	1.86	1.38

Table XII—Cost of Hydro Output Delivered at End of Transmission Line: Mills per Kilowatt-Hour

Hydro Plant Cost (Firm Capacity)		200 Miles	100 Miles	50 Miles
$125 Per Kw.	Generation.....	3.30	3.30	3.30
	Transmission.....	2.42	1.92	1.65
	Total.....	5.72	5.22	4.95
$105 per kw.	Generation.....	2.82	2.82	2.82
	Transmission.....	2.42	1.92	1.65
	Total.....	5.24	4.74	4.47
$85 per kw.	Generation.....	2.34	2.34	2.34
	Transmission.....	2.42	1.92	1.65
	Total.....	4.76	4.26	3.99
$65 per kw.	Generation.....	1.86	1.86	1.86
	Transmission.....	2.42	1.92	1.65
	Total.....	4.28	3.78	3.51
$45 per kw.	Generation.....	1.38	1.38	1.38
	Transmission.....	2.42	1.92	1.65
	Total.....	3.80	3.30	3.03

In the previous estimate of the cost of hydro power at the dam site, based on an investment of $250 per kilowatt of firm capacity, the advantage was clearly in favor of steam. However, there are hydro sites where the cost of development is lower, and therefore estimates have been prepared to show the cost of hydro power as the investment per unit becomes less. These results are shown in Table XI, from which it will be apparent that when the investment is relatively low the power becomes very cheap. However, the hydro power must be transmitted to market, and Table XII shows the total cost at the market center, for various transmission distances up to 200 miles.

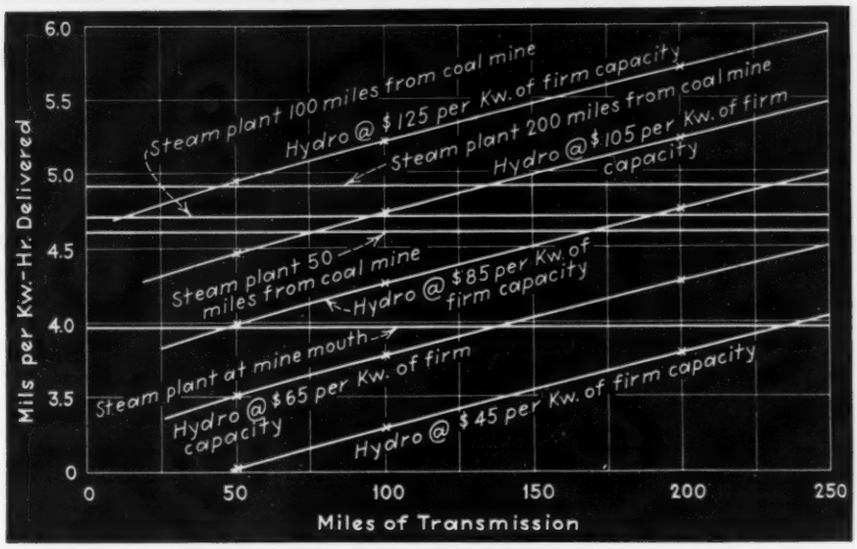

Mils per Kw.-Hr. Delivered
Miles of Transmission
Steam plant 100 miles from coal mine
Hydro @ $125 per Kw. of firm capacity
Steam plant 200 miles from coal mine
Hydro @ $105 per Kw. of firm capacity
Steam plant 50 miles from coal mine
Hydro @ $85 per Kw. of firm capacity
Steam plant at mine mouth
Hydro @ $65 per Kw. of firm capacity
Hydro @ $45 per Kw. of firm capacity

Fig. 2 — Cost of hydro power plus transmission versus steam power plus coal haul

Over-all costs compared

The results shown in Tables X and XII are presented graphically in Fig. 2. These graphs show the cost of power delivered at the market from distant hydro plants of various hypothetical costs per kilowatt, and from steam plants at the market with varying lengths of coal haul by rail. The graphs showing the cost of hydro power are all similar, and it will be noted that they intersect the graphs of the cost of steam power at various points. Such intersections, naturally, represent equal costs from hydro and steam. These points of intersection, on the scale of abscissas, represent various distances of transmission of hydro power which result in equality of cost with steam. These mileages have been determined from Fig. 2 by inspection and used to construct the graph shown in Fig. 3.

The purpose of Fig. 3 is to bring out the cost of hydro per kilowatt, such that when the power is transmitted a given distance the total cost per kilowatt-hour will equal that from a steam plant to which the coal is hauled by rail for various distances. As a concrete example, assuming a steam plant at the market center and 200 miles from a coal mine, it appears from the uppermost graph that a hydro plant costing about $112 per firm kilowatt and located 100 miles from the market would deliver firm power at the same cost as steam. Taking again the same steam plant, if the hydro plant cost only $80 per firm kilowatt it could be 250 miles from the market and still compete with steam.

The graphs in Fig. 2 also show, of course, that secondary hydro power, for which the additional plant capacity costs relatively little, can be generated at very low cost. However, it must be supplemented with power from another source, usually steam, generated from coal, oil or natural gas. For this reason there are few hydro developments in the United States which are not interconnected with steam.

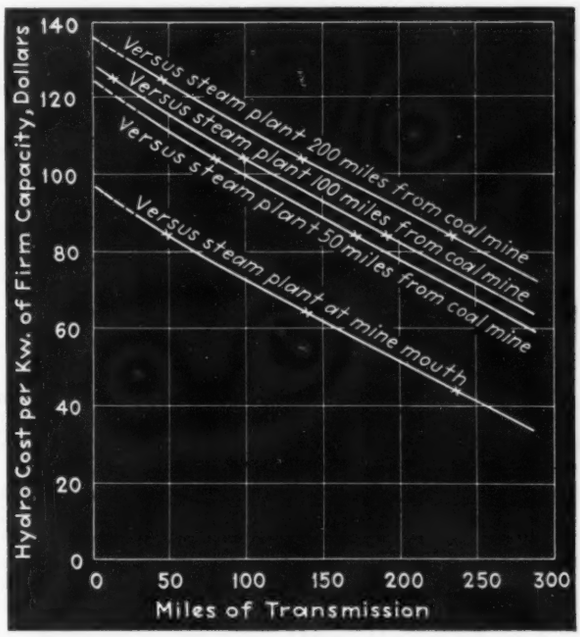

Hydro Cost per Kw. of Firm Capacity, Dollars
Miles of Transmission
Versus steam plant 200 miles from coal mine
Versus steam plant 100 miles from coal mine
Versus steam plant 50 miles from coal mine
Versus steam plant at mine mouth

Fig. 3 — Unit cost of hydro plant such that cost of hydro generation plus transmission equals cost of steam generation plus coal haul

Enough has been presented to make it reasonably clear that the economic trend of the future, in supplying large metropolitan load centers, will be toward steam plants located as near the market as practicable, except where circulating water is unobtainable or too expensive, or fuel costs are prohibitive. Transmission facilities will continue to be essential for interconnecting the bulk sources of supply and taking the bulk power to market centers. Additional hydro sites which can be economically developed in combination with supplemental steam power will be attractive when not too far from markets, but projects of this type should receive even more careful scrutiny than has been given them heretofore. Future projects of the Boulder Dam type will be very questionable at best.

System interconnection

There is today more or less propaganda for more extensive interconnection of adjacent power systems and interchange of energy. If carried out as a national policy the trend would be toward a country-wide interconnected network of long-distance, high-voltage transmission lines. The facts brought out in this paper tend to prove, however, that such a program would be uneconomic. Interconnection already exists on a very extensive scale. As a matter of fact, thousands of miles

Table XIII—Summary of Fourteen Federal Hydro Projects Under Construction or Contemplated

(Data on cost and ultimate output compiled by U. S. Chamber of Commerce)

Zone	Project	Ultimate Cost	Ultimate Output (Kw.)	Cost Per Kilowatt of Ultimate Output	Average Cost Per Kilowatt of Dependable Capacity†
1	Passamaquoddy	$34,000,000	44,800	$759	$1,160
2	(None)	.....	.....	...	...
4	*Caspar-Alcova	22,700,000	37,300	609	929
4	*Fort Peck	110,000,000	298,000	369	564
5	(None)	.....	.....	...	.....
	Sub-total	$166,700,000	380,100	439	670
3	*Wilson Dam	63,000,000	537,000	117	179
3	*Norris Dam	34,000,000	164,000	207	317
3	*Wheeler Dam	40,000,000	298,000	134	205
3	*Pickwick Dam	42,000,000	343,000	122	187
3	Guntersville Dam	27,000,000	175,000	154	236
3	Chickamauga Dam	$28,000,000	209,000	134	205
3	*Tygart	15,700,000	17,200	913	1,390
6	*Grand Coulee	400,000,000	1,865,000	204	328
6	*Bonneville	46,000,000	448,000	103	157
7	*Boulder Dam	165,000,000	1,120,000	147	225
7	Central Valley	170,000,000	261,000	652	995
	Sub-total	1,030,700,000	5,437,200	190	290
	Total U. S. A.	$1,197,400,000	5,817,300	$206	$314

*Total expended on these projects to June 30, 1935, $211,400,000.

†National average dependable capacity equals 65.5 per cent of installed capacity: obviously this is lower in dry years.

of transmission circuits of different systems are normally operated in parallel every day, but not primarily for long-distance transmission of energy. Interconnection exists chiefly for emergency transfer of energy from the fringe of one power system to the fringe of a neighboring system.

A collateral advantage of interconnection, frequently realized, is the possibility of energy interchanges at various hours of the day in response to diversity in system peaks. These improvements in load factor sometimes result in appreciable economies, if the interconnection does not involve too great lengths of transmission and substantial energy losses.

Federal hydro projects

From a list prepared by the Federal Power Commission it appears that the ultimate capacity in seven federal projects is to be 3,158,500 kw. and the initial 765,900 kw., or 24 per cent of the proposed ultimate.

Recently the United States Chamber of Commerce compiled and published figures of ultimate installed capacity and estimated total cost for fourteen federal hydro projects, as shown in Table XIII. The average cost per kilowatt of ultimate capacity is $206. The national average ratio of firm output to installed capacity is 65.5 per cent,* and the application of this figure shows an average cost of $314 per kilowatt of firm capacity.

Examination of these individual projects shows that Passamaquoddy, Caspar-Alcova, Fort Peck, Tygart and Central Valley are hopelessly uneconomic as power developments. These five projects should never be developed with anyone's money, public or private. Disregarding these five, the remaining nine have an average cost of $164 per kilowatt of ultimate installed capacity, or $250 per kilowatt of ultimate firm capacity. The latter figure is the same as that selected for the comparison of hydro power with a modern steam plant, previously presented. Of course with only 24 per cent initial installation, the production costs will be far in excess of the cost of modern steam power as long as that condition exists.

Certain differences appear between the figures for ultimate capacity for the seven projects listed by the Federal Power Commission and the corresponding figures in Table XIII. Therefore, the capacities shown in the commission's tabulation and the costs shown in Table XIII, for these seven projects, have been reassembled in Table XIV, and the average cost per kilowatt of ultimate capacity is $259, or per kilowatt of average firm capacity is $395.

Looking only at ultimate development, projects such as Wilson, Wheeler, Pickwick and Chickamauga, and particularly Bonneville, offer some hope of economical results if properly co-ordinated with supplemental modern steam plants, provided there are neighboring markets to absorb the power. But the first four will develop over 1,300,000 kw. and the fifth 430,000 kw. The prospect of finding adequate markets within economic distance seems to have received scant study. It seems inevitable that this power cannot be put to economical uses for years to come, if ever, and will be a temptation to plunge the government into the power business.

Let it not be said that engineers failed to come forward with a remedy to safeguard private enterprise and the millions of people dependent on it. The best economic remedy which can now be devised is for the government to suspend development of power on all of these projects, and in future develop only so much of the potential power as the private utilities can economically absorb and distribute to the power markets of the country. Let the government co-operate with private industry instead of engaging in ruinous competition.

Table XIV—Summary of Seven Federal Hydro Projects Under Construction

(Data on initial and ultimate capacity from Federal Power Survey)

(Data on ultimate cost compiled by U. S. Chamber of Commerce)

Zone	Project	Initial Capacity (Kw.)	Ultimate Capacity (Kw.)	Ultimate Cost	Cost Per Kilowatt of Ultimate Capacity
3	Norris Dam	100,000	100,000	$34,000,000	$340
	Wheeler Dam	32,000	256,000	40,000,000	156
4	Fort Peck	50,000	400,000	110,000,000	275
	Caspar-Alcova	25,000	38,000	22,700,000	598
6	Grand Coulee	102,900	617,000	400,000,000	649
	Bonnerville	86,000	430,000	46,000,000	107
7	Boulder Canyon	370,000	1,317,500	165,000,000	125
	Total	765,900	3,158,500	$817,700,000	$259

*Federal Power Commission.

Utility Revenue Up 6.3%

MARCH operations of electric light and power companies brought 6.3 per cent more revenue than a year ago, with an increase of 11.8 per cent in energy output, the former amounting to $165,650,200, according to the Edison Electric Institute, and the output to 8,434,400,000 kw.-hr. The income was virtually up to the figure attained six years ago and it was higher than in March of any other year, but to earn it the industry had to sell 11 per cent more kilowatt-hours than in 1930.

March Revenue, 6.3 Per Cent Above 1935, Matches 1930 Record — Energy Sales, Up 13.7 Per Cent, Set New High for Month

Comparing like months in order to take into account the usual seasonal variations, earnings have been holding close to the amounts of the best previous years since last August. This condition continues. The increase over the preceding year was the largest for any month since pre-depression times.

Energy production remains on a higher level than ever before, 10 per cent above the March record of 1930 and 11 per cent above 1929.

In conformity with the usual movement in spring, the revenue decreased 3.3 per cent from February and 7.6 per cent from January. Average daily energy production was 272,000,000 kw.-hr., against 280,000,000 kw.-hr. in January. Production in March was appreciably affected by flood conditions, especially in New England.

Water power contributed 42.5 per cent of the total output, but increased only 5.7 per cent over a year ago, whereas production from fuels increased 16.5 per cent.

Regional gains in revenue over last year were small in the Northeast, but rose to 11.5 per cent in the Southeast and around 9 per cent in the far West. Energy production decreased slightly in New England, but was larger than in 1935 in all other parts of the country, the maximum increase being 21.7 per cent in the South Atlantic states. Considerably more energy than a year ago is being produced from fuels. The excess was smaller in March than in February, but nevertheless ran as high as 27.5 per cent in New England and 25.2 per cent in the South Atlantic area.

It is worth noting that the changes listed in Table III brought each of the three major items, as well as total energy sales to ultimate consumers, to a higher level than in any previous March.

For the twelve-month period the average consumption per residential customer was 688 kw.-hr., against 639 kw.-hr. for the preceding like period, and the average price per kilowatt-hour fell further to 4.93 cents.

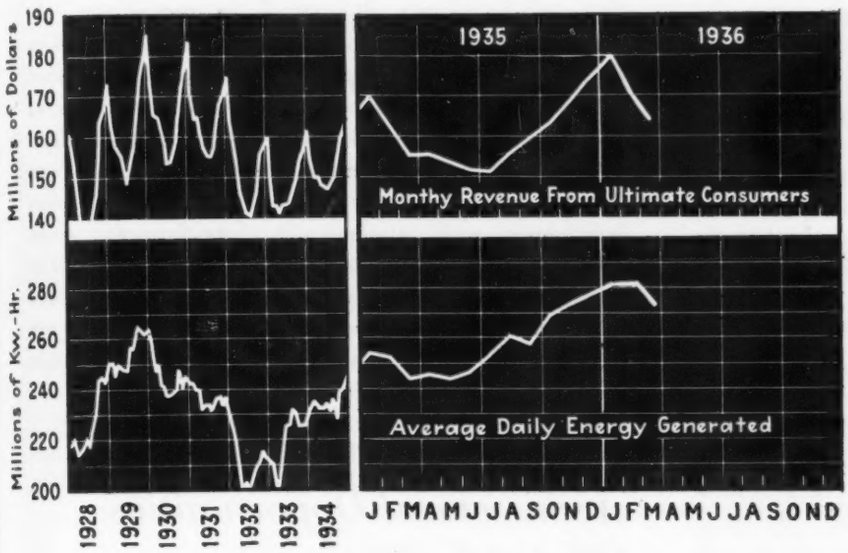


Table I—Monthly Revenue from Ultimate Consumers and Energy Output of Central Stations in the United States

Compared with Corresponding Month of Previous Year

Month 1936	Revenue from Ultimate Consumers†		Energy Generated, Millions of Kw.-Hr.*					
			Total		Hydro		Fuel	
	Thousands of Dollars	Per Cent Inc.	Gen.	Per Cent Inc.	Gen.	Per Cent Inc.	Gen.	Per Cent. Inc.
March	165,650	+6.3	8,434	+11.8	3,591	+5.7	4,843	+16.5
February	171,219	+5.4	8,120	+14.6	2,775	—2.2	5,345	+26.9
January	179,141	+5.3	8,745	+11.0	3,207	+3.3	5,538	+16.7
1935 December	173,459	+5.9	8,580	+13.0	3,069	+1.0	5,511	+21.0

Table II—Regional Revenue and Energy Output in March, 1936

Compared with Corresponding Month of Previous Year

Geographical Region	Revenue from Ult. Consumers		Energy Generated, Millions of Kw.-Hr.*					
			Total		Hydro		Fuel	
	Thousands of Dollars	Per Cent Inc.	Gen.	Per Cent Inc.	Gen.	Per Cent Inc.	Gen.	Per Cent Inc.
United States	165,650	+ 6.3	8,434	+11.8	3,591	+ 5.7	4,843	+16.5
New England	13,826	+ 2.2	529	— 1.0	237	—22.2	292	+27.5
Middle Atlantic	47,627	+ 1.3	2,067	+11.0	736	+ 0.8	1,331	+17.5
East No. Central	39,834	+ 9.1	2,064	+13.2	222	—15.2	1,842	+18.0
West No. Central	14,407	+ 8.9	541	+ 5.5	158	—19.7	383	+21.3
South Atlantic / East So. Central	21,082	+11.5	1,157 / 356	+21.7 / + 7.8	778 / 292	+20.0 / + 4.9	379 / 64	+25.2 / +22.0
West So. Central	8,643	+ 6.0	385	+11.8	13	—54.8	372	+18.0
Mountain	4,890	+ 9.5	295	+20.0	220	+22.0	75	+14.6
Pacific	15,341	+ 8.5	1,040	+14.3	935	+23.7	105	—31.8

*By courtesy of U. S. Geological Survey, with deductions for operations not regarded as central station.
†Preliminary, Edison Electric Institute.

Table III—Allocation of Energy March, 1936

Compared with Corresponding Month of Previous Year
(Edison Electric Institute)

Class of Service	Millions of Kw.-Hr.	Per Cent Inc.
Total for distribution*	8,375	+11.7
Lost in transmission, etc.	1,462	+ 3.0
Sold to ultimate consumers	6,913	+13.7
Domestic	1,254	+11.4
Com'l, small light and power	1,256	+12.1
Com'l, large light and power	3,649	+16.4
Municipal street lighting	209	+ 4.3
Railways—street, interurban	394	+ 2.5
Railroads—electrified steam	83	+24.3
Municipal and miscellaneous	68	+36.4

*Generated, purchased from other sources, imported, less energy used in railway and other departments.

ELECTRICAL WORLD

L. W. W. MORROW · EDITOR

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Hosts to World Power Delegates

THOUSANDS of executives and engineers interested in power and natural resources will gather in Washington September 5. This country is host to the Third World Power Conference delegates. This meeting, with its accompanying tours, is a truly international affair of major magnitude. It evokes our most cordial hospitality. It brings to bear the greatest international group of experts on power ever assembled. It stands out as an international meeting of major magnitude.

This conference is no place to accent our local national politics or differences of opinion. Those in charge assure us that this conference is to be factual, objective and international in character. The papers are written to this specification, and this is the reason that leaders of the electrical industry are back of the conference. Those who attended previous conferences in London and Berlin understand the high standards and caliber of this event and how difficult it will be for us to measure up to previous meetings.

We hope the rumor-mongers and petty minds will not mar this conference. It should mean a great deal to the world and we have a chance to show the world what we have done in this country. It is an occasion for international amity and education. We should be proud to be hosts and to show our wares. Every possible encouragement should be given to make this a notable affair.

We challenge the competency of some of the authors of the papers scheduled. They are observers, rather than experts who know what they are talking about. But the use of two authors in many instances permits our true experts to treat the subject matter and thus minimizes this criticism. Since the papers are to be presented by title, the heart of the meetings will lie in the discussions. We hope our best experts will attend and participate. The World Power Conference is an international movement that deserves our best efforts to make it succeed. We are confident of the constructive results of the meeting in this country.

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Will Rural Life Be Less Abundant?

EVERYBODY'S interested in rural electrification, the hard-working bureaus in Washington, the co-operative associations, the eager-to-please utilities—in fact, everybody but the farmer.

Our radios have pulsated with sonorous voices pleading the plight of six million American farms, and for a while we got all worked up over six million farmers' wives carrying six million times four buckets of water up to their respective back stoops every day.

But facts are stubborn things. We hear now of rural lines built in 1936 which pass by farms without a pause, much less a distribution transformer. Now they tell us more than 6 per cent of the farms are *sans* farmhouses, and automatically, *sans* farmers' wives, *sans* water buckets and *sans* even back stoops. Add to this 6 per cent, 40 per cent more which are adorned with houses valued at less than $500 each, and it is easy to understand why the radio speakers' pulsations might well have been cut in half.

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Architectural Opportunities Offered Utilities

WITH the renewal of utility system expansion there is bound to develop a need for erection of new office and commercial buildings. This need may arise out of the inadequacy of the old quarters, out of a desire to own the principal place where the business is being transacted, or out of the need for additional new quarters. In any event, whenever the situation develops and whatever the cause, it is well to remember that architecture and architectural ideas have been on the move and have progressed in the past five or six years.

All of this is perhaps superfluous in dealing with the larger office building—with buildings, say, of 100,000 to 1,000,000 cubic feet—where competent architectural services are certain to be employed. But in the smaller buildings and in those involving 10,000 to 30,000 cubic feet, in particular, architecture may frequently as likely as not be looked upon as a luxury. Here it is well to remember that true architecture, involving proper arrangement of surface and mass, proper layout of working quarters to meet their functional requirements, arrangement of lighting and ventilation, use of economical materials, is even more important if the rococo and the dowdy are to be

avoided. The application in these buildings of sound and modern architecture, with its emphasis on the utilitarian motive and stressing of lighting and ventilation, gives the utility an opportunity not only to obtain an economical, modern and dignified home, but, what is at least as important, also the privilege of advancing progressive architecture in office and home construction. Any such advance will automatically advance the use of electricity, and with it the art of living.

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Go Light With the Gadgets

LIGHTING is radiation architecture. Once the job has been intelligently done, many of the little efforts to make improvements lead to unbalances and excrescences. In a show window, for example, those efforts can spoil the effect as completely as gables, ells and dormers gave the mansion architecture of the '90s a nondescript, gingerbread appearance.

One stroll up and down our main stems will reveal what is happening to too many well-conceived store-window lighting installations. Some one comes along with a gimmick that affords some opportunity to get a shot of light at a new angle, a new concentration or with a new pastel tone. Sure, just one of them may fit occasionally into the scheme of things for a special purpose, but likely as not the promiscuous use of several will ruin all the dignity of the bathed-in-light effect that the illuminating engineer built into a versatile installation.

Until window dressers become as adept at applying the technique of light as they are in placing their forms and their wares they would do well to avoid trying to improve piecemeal on the installation which a competent illumination engineer has given them.

•

Beyond the Cream Skimming

DETAILS of the National Electric Kitchen Bureau program have just been distributed in prospectus form. The plan is excellent and most encouraging. The industry is organizing for a big job, with the National Electrical Manufacturers Association and the Edison Electric Institute hitched together like a team of good gray horses, ready to pull the load. There are two ways to go about it, of course. The usual and natural way is to shoot at people with money, to skim the cream first. But there is no reason why the kitchen idea should not be applied to both cream and milk.

Mrs. Christine Fredericks, the noted authority on domestic engineering, commented on this the other day. The average woman, she says, is tired of the chromium glitter of the kitchens pictured in the women's magazines, because she doesn't see this de luxe equipment fitting into her home. She hasn't that kind of a kitchen and can't visualize so idealistic a transformation, in the unattractive, ill-equipped room where she does her own cooking.

In a sizable percentage of the homes that use electricity the kitchen is also the dining room, and often the room where the family does much of its living. Chairs comfortable to sit in must be provided as well as labor-saving appliances, Mrs. Fredericks points out. And the housekeeper must be convinced that you are talking to her and about her home before she will respond to your selling.

In other words, there are more modest homes than luxurious ones. So there is need for kitchen planning for this greater market, layouts that will fit the farmhouse and the small-town cottage. And there is no reason why in the coming electric kitchen campaign we should not talk to both classes of customers. For it is in these humble homes that electricity can do its best work.

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Gaskets—A Major Electrical Equipment Problem

CONSIDER the lowly gasket and the influential part it plays in the performance of electrical equipment. In bushings, in potheads, in power transformers, in submersible protectors and distribution transformers, in hydrogen shells, in lightning arresters, in coupling capacitors, and in a great deal of other electrical equipment, gaskets are depended upon to keep moisture and contamination out and frequently oil or other insulating materials in. Yet, in reviewing experience over several decades, it is astonishing how frequently the performance of this function has been unsuccessful.

This failure, too, has not been confined to one class of apparatus or one material. Lead, cork, rubber, velluminoid and felt, all have been used and all found to have initial or aging weak spots. Perhaps the most promising materials introduced in the past few years have been the artificial rubbers, such as thiokol and duprene. But neither the application of these materials nor the weaknesses of the older ones have been studied with any of the thoroughness that is necessary.

Yet considering the importance of the subject, would it not warrant a really exhaustive research? The problem of keeping a structure water and moisture tight is almost as old as the electric power industry, and certainly as old as the high-tension art. That it has not as yet been satisfactorily solved is admitting the existence of a ludicrously shameful state of affairs. It would be well to terminate this. There ought to be found a group who would undertake this seemingly simple but important problem and bring to it a solution satisfactory for the present state of the electrical power art.

Government Tilts at Business

TIME was when business had a voice in Washington. Most of the time, in those days, it was not just a sound; in fact, it made no noise at all. But it came pretty close to being a red light for what business did not want, and a green light for what it did.

Business had this power because it acted intelligently, playing the game according to the rules as they then were, and getting results. Perhaps it overdid it, though there are many who will contend that the net result was a good thing for the country. As, for instance, when the steel makers wrote the tariff schedules on steel, the wool manufacturers on wool, etc. Mr. Ultimate Consumer may have paid too much for the things he bought, but the country as a whole prospered and grew rich—grew to the highest standards of living in the world.

But the silent control of politics by business was a little too obvious. It roused resentment. Gradually there grew up in the West and South particularly the conviction that the government was run, through the Old Guard of both Republican and Democratic parties, in the interest of the rich.

There is no argument about the accuracy of that. The only argument, and it is seldom made, is that such a conduct of the government worked out better for everybody, rich or poor—that when business called on the government, through the then existing channels, to do any particular thing, business profited thereby, but that the results benefited everybody else as well.

All of which is apropos today because of the remarkable demonstration at Cleveland that the last vestige of power had passed from what we used to call the "Old Guard." And because at Philadelphia we see the Democratic national convention dominated by men who have made their political capital by kicking the "interests" and business generally around.

YET this loss of its voice in Washington has almost kept step with a tilting curve of increasing importance of Washington to business. Every passing year for the last generation has seen an advance in this importance. The government's hand is heavier on business than ever before in history—will be heavier before it is lighter. If it *ever* is lighter. Its levies on profits, when there are profits; its growing battery of regulatory and investigating agencies, its constant threat of something else that had not been expected.

There is no indication that this progressive tightening of the government's toll on profits, government regulation of how the profits may be obtained and distributed and government interference with the relations as to working conditions, hours of pay for employees, and as to how the books must be kept, are to be modified. All evidences indicate that they will increase.

Taxes *must* be higher next year. Government invasion of hitherto untouched fields marches on. May continue to march even if Landon is elected. It is terribly hard to curb government expenses, or to resist popular demands for new regulatory laws.

Roosevelt promised eagerly, in July, 1932, to reduce governmental expenses 25 per cent. In fact, shortly after his inauguration he shaved the pay of regular civil service workers, army and navy officers, even congressmen. But then the big spending wave set in. The economies already effected appeared ridiculous and were abolished.

It is a generally accepted idea in this country that our best brains drift into business—or into that branch of the legal profession that advises business. If this is true it seems a little strange that almost in the same ratio as government increased its importance to business, business lost control of the government.

THERE is a very simple answer to this, but the writer has never happened to talk with an important business man who understood it. The answer is that the rules in this great game of politics have changed, but that such business men as try to keep their hands in are still trying to play according to the old rules. It has been as futile as sending a wooden frigate against a dreadnought. Or using muzzle loaders against machine guns.

Let's look at the picture as it used to be. Mind you, this change really began with William Jennings Bryan. It was none other than the Peerless Leader who first declared that New York was the "enemy country," who first won a following for the idea that the wicked forces of intrenched greed filled their pockets by impoverishing the rest of the country. He did not win, either in 1896 or in 1900, but the seed he planted then has not only sprouted, but been harvested.

Meanwhile, during the years between the planting by Bryan, the cultivation by Theodore Roosevelt, with his "Malefactors of Great Wealth" while President and his "Pass Prosperity Around" in 1912, after the Old Guard had refused him the Republican nomination, and the harvest of Franklin D. Roosevelt, the old contact between business and Washington slowly withered as the rules changed.

What happened was that what we used to call the big state bosses in party organizations lost their grip. They grew old. They died. They were defeated. Men who sought to take their places were inept. They simply were not big enough.

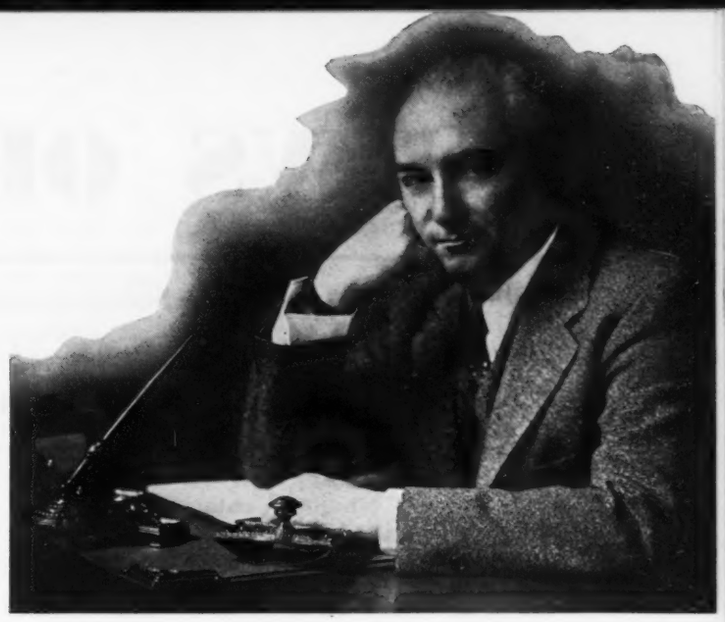
The process was hastened by several developments. First, there was the direct primary. Then there was the direct election of senators. Most important of all, there was publicity for campaign contributions and expenditures, with senatorial committees and eager reporters prying into state contests.

In the old days the political set-up was a comparatively simple thing. Even a business man or manufacturer who devoted most of his waking hours to getting the better of his competitors knew how to play his political cards. The thing to do was to make fat contributions to the war chest of whichever party was dominant in his state, and have a partner or lieutenant make liberal gifts to the minority party. Then, when some crank from the backward states seemed to be getting a following for some governmental proposal which would play hob with your business, you merely called the attention of the state bosses to the situation. You didn't even have to enlist your colleagues in the same line in other states. They would be doing the same thing, automatically.

Whereupon Murray Crane, or Boies Penrose, or Sen-

—By CARTER FIELD

This noted journalist gives his personal comments and interpretations on current happenings affecting the electrical industry. His background and his location at Washington make his thoughts informative and interesting even though all may not agree with him.



ator Platt, or whoever happened to be the bosses at the time, moved into action. The crusade was squelched. For Penrose and Crane and Platt, to name just three of the big old names, had influence enough nationally to do things that nowadays seem impossible.

For when their colleagues in the "College of Bosses," sometimes called in those days the national committee, needed help on something or other they were always available. The senators from Kansas, or Minnesota, or Colorado suddenly discovered that there was an overwhelming sentiment in their states against this new reform proposal. They would be informed to that effect by the bosses of their states, who controlled the legislatures—and later on the machines—which elected the senators, the bosses being anxious to pay off debts of gratitude generally due to big campaign contributions reaching them indirectly through the Northeastern bosses.

The business men who had so successfully used experts in what to them was a strange and ununderstandable game —politics—were completely at sea when the bosses they had used either died or passed out of the picture. Sometimes they attempted to operate directly, and most of the times they did they bungled badly. The situation with regard to the electrical industry in New York State is a perfect example.

Sometimes, particularly in the utility field, they attempted to create good will, either by advertising and publicity or by inducing huge numbers of voters in given communities to become stockholders. Often they were pounced on for such things as buying newspapers, attempting to inject their conception of sound economics into schoolbooks, retainers to college professors, etc.

PASSING of the bosses resulted in a distinctly lower caliber of men in public life, particularly in the U. S. Senate. Where there was a strong boss, or a strong organization, the senator did not have to be a demagogue. In fact, for one reason and another, the bosses took pride in sending the ablest men available to the Senate.

But, with the bosses impotent or gone, and with public opinion built up that all big business is wicked, the safe thing politically for a would-be representative or senator has come to be to shout against special privilege and the "interests."

For business, meanwhile, had practically withdrawn from politics entirely, save where it attempted, bull-in-china-shop fashion, to inject itself in a situation already crystallized in the written words of pending legislation, whether it be in state legislatures or on Capitol Hill in Washington.

A perfect demonstration of how the game can be played under the new rules can be obtained by a study of how Alf M. Landon was nominated for the presidency at Cleveland—or rather by work done beginning some eighteen months before that convention was called to order. Everybody knows the spade work was done by a very shrewd editor, Roy A. Roberts of the Kansas City *Star*, and by John D. M. Hamilton, trained politically at the knee of one of the shrewdest of the old-time bosses, Dave Mulvane of Kansas. What is not so well known is that a group of independent oil operators, some of them from New York State, and with political connections going back to the boss days, got very active in the picture.

William Allen White almost let the cat out of the bag when he admitted, in a signed syndicated story, that Hamilton had raised some money in "downtown New York." White must have had a mental lapse, thinking he was just an independent writer again and not sitting in the Landon councils.

BUT the point is that if business is to regain the voice in Washington it should have, not only for its own sake but for the sake of its workers, and of the country, it must get back into politics. Not by the old route. Its bridges are all washed out. But by the new. Not at the top, where it used to operate, but down at the grass roots. Not nationally, but in organization work in each congressional and legislative district of every state.

This does not mean that men connected with big business institutions have to get themselves elected to the legislatures of their states, or to Congress. Though a sprinkling of them might not be a bad idea. But that they should take an interest in every doing of their own precinct and district organizations, so that they would have a voice in the selection of candidates and the building up of the organization.

Then, when some measure which means tough sledding for the enterprise which provides their living comes up in Washington, senators and representatives will hear from their own political lieutenants—for such the business men should be—that this thing means trouble for them.

It would take very little of that sort of thing to make such a Congress as the one which has operated for the last two years, or the one which served the two first years of Roosevelt's Administration, impossible. As pointed out in a recent article, a very small minority in any state or congressional district can work wonders with its senator or congressman, *if* he is sure about the determination of that minority.

NEWS OF THE WEEK

Jubilee Celebration at Schenectady Honors Edison and Co-founders . . . Utilities Accelerate Rural Construction . . . Utility Security Offerings to Be Influenced by Market Conditions . . . Power Policy Indicates Army Engineers-Power Commission Control

Distinguished Group Honors Edison Entree to Schenectady

Owen D. Young, Gerard Swope, Henry Ford, Harvey Firestone, Charles Edison, George R. Lunn, William S. Barstow and Governor Lehman laud Edison and co-founders of electrical industry.

A half century of the electrical industry in Schenectady, N. Y., was celebrated by a golden jubilee June 12 and 13 which included a formal dinner in tribute to Thomas Alva Edison and his pioneering associates of 1886, a nation-wide broadcast of a skit depicting Edison's arrival in Schenectady and a wholehearted participation in a score of jubilee festivities by Schenectady citizens and visitors.

For the formal dinner Friday evening at seven, seemingly hundreds crowded into the Hotel Van Curler ballroom to mingle with Edison Pioneers, with associate pioneers, with officers and directors of the General Electric Company and with other guests of the Schenectady Chamber of Commerce introduced by Toastmaster Dixon Ryan Fox, president of Union College. After the dinner one of the gangling bipolar dynamos created by Mr. Edison in his machine works was started, and it lighted a replica of the first incandescent lamp. An "electric eye" caught the gleam, in turn actuated relays which, closing, lighted for the first time the ornamental sodium lighting system on Schenectady's mile-long Great Western Gateway Bridge.

Many telegrams received

Telegrams from Henry Ford, Harvey S. Firestone, President Roosevelt, Chief Justice Hughes, Senator Copeland, Governor Lehman, New York City's Mayor LaGuardia, Martin J. Insull, Samuel Insull, Jr., and others expressed regrets at being unable to attend and lauded the achievements of Edison.

"Not only did Mr. Edison lay the scientific and material foundation of the electrical industry," read Mr. Ford's telegram, "but he was guided by an economic principle of lower prices, genuine service, open and free competition—a competition of merit which would be beneficial for all business to observe today."

Public Service Commissioner George R. Lunn drew a stirring word-picture of the industry's accomplishments of the past fifty years, summed up the electrical industry as one of "the real creators of wealth—wealth which cannot be estimated in terms of money, but in terms of greater ease, comfort and happiness for all. This is real wealth," Mr. Lunn added, "which may be enjoyed by the masses of people throughout the world who, I am sure, would join me in heartily congratulating General Electric Company on this fifty years of progress."

Significance of event

Interesting, unusual, human sidelights on the character of Edison the man were described by his son, Charles Edison, and by Edison Foundation's president, William S. Barstow.

In conclusion, Owen D. Young, introduced by Toastmaster Fox as a "master of human adjustments," rose to translate for the assemblage the real significance of an event truly distinguished. Relegating tangibles such as acres of floor space, numbers of workers, volume of output or items on balance sheets to secondary importance for the moment, the speaker asked: "What was the power, the driving force that created the great something of today out of the nothing of fifty years ago? To make that discovery would be helpful, not only in interpreting the history of the fifty years gone by, but it would enable us all to throw a searchlight on the future. . . .

"The vision of Thomas A. Edison was not impaired by hopelessness. His industry was not limited by rules or plans. The story of his life makes a jest of the slogan 'What is not, can't be,'" Mr. Young told a hushed audience.

"With all the advance that has been made in fifty years, would any one dare say tonight to Elihu Thomson or to Willis R. Whitney, or to the great investigators in the research laboratories, or to the application engineers, or even to the most modest worker in this plant that what is, is, and what is not, can't be?

"Every sunrise gives the lie to such depressing realism. That fact is, that that is not real at all.

"Mr. Chairman, we celebrate tonight more than what has been. We celebrate the unreality of what is, and the certainty of what is to be. By so doing, we assert that a nation, like a man, recovers from depression by confident effort and not by hopeless surrender. If that be the lesson of this night, you will have rendered the greatest service to your countrymen."

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U. S. Power Policy Nears Clarification

Duplicate bills providing for the operation of the Bonneville hydro-electric project on the Columbia River and establishing the Federal Power Commission as a rate-regulating agency for all sales of surplus power by the federal government have been favorably reported to both the House and the Senate and there is strong possibility that this legislation may pass, say Washington advices to ELECTRICAL WORLD.

The bulk of the bill is devoted to the Bonneville project, the operation and maintenance of which is placed in the hands of the Secretary of War and the Chief of Engineers. Surplus electrical energy may be sold at wholesale at rates to be set by the Federal Power Commission, preference being given in the allotment of power to states, their political subdivisions and co-operative organizations. After these demands are met any additional power available may be sold to private corporations. The War Department is empowered to construct such transmission lines and distribution facilities as may be necessary.

Extensive Rural Plans Announced

Utilities in Indiana, Wisconsin, Texas and Florida to extend service — R.E.A. activities — Miami-Shelby project completed

Of vital interest to rural residents in southern Indiana is the announcement by officials of the Southern Indiana Gas & Electric Company of Evansville of a new rural extension plan that will facilitate the use of electricity in rural communities. The company, on request, will build rural line extensions at its own expense when each original customer has guaranteed to the company, as a minimum monthly payment, an amount which, added to the other guaranteed minimum payments, totals $12.50 per month per mile of such extension. The right-of-way for the lines is to be furnished by the customers.

Wisconsin Public Service Commission has given the Wisconsin-Michigan Power Company blanket authority to make electric line extensions, without further approval, in all but fourteen of the 53 towns it serves in Brown, Calumet, Oconto, Outagamie, Shawano, Waupaca, Waushara and Winnebago counties. Objections to such authority had been raised by the state rural electrification co-ordination office on the ground that the R.E.A. wanted to be in a position to determine whether there was any interference with its co-operative projects. The commission declared that more specific information should be presented where an objection to private line extensions is made. The application made by the power company was based on a demand for service by 450 prospective customers.

Texas Power & Light Company now has under construction or recently completed 70 miles of rural electric power transmission lines in Hopkins County. These lines will serve more than 500 farm homes. Surveys are being made for 45 miles of additional transmission lines in the county.

Florida utility gets loan

Florida Public Service Company, Orlando, has recently obtained a $48,500 loan from the R.E.A. to build 60 miles of extension serving 241 families in Orange, Seminole, Highlands, Volusia, Lake and Polk counties.

A 25-year franchise to the Tri-County Rural Electric Co-operative, Inc., to put up poles and maintain lines in the western part of Lucas County, Ohio, was granted by county commissioners. Specifically the territory involved embraces Richfield, Spencer, Swanton, Harding and Providence townships.

Directors of the Southeastern Nebraska Public Power District at Beatrice, Neb., have awarded the contract for constructing 450 miles of lines in Gage County to C. F. Lytle of Sioux City, Iowa. The contract, which is for a total sum of $366,596, is subject to the approval of the R.E.A. administrator. The lines are to be completed within six months. The district's application to the Nebraska Railway Commission for permission to build the lines has not yet been approved.

Miami-Shelby project completed

The Miami-Shelby county project in Ohio has just been completed. The estimated cost of the project was $309,000 for Shelby County, with 345 miles of line, and $221,000 in Miami County, with 240 miles of line. Work in a Champaign County project, which has been delayed by litigation, was to have started this week. It will cost approximately $447,000 and will serve about 1,900 patrons over 440 miles of line.

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Refrigerator Sales Increase 83 per Cent

Public Service Electric & Gas Company reports the sale of a larger volume of electrical appliances during the first five months of 1936 than in the similar period of any previous year except 1929. Electric and gas refrigerator sales during May were the largest of any month in the company's history.

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Utility to Promote Range Sales

The Birmingham Electric Company began on June 1 to promote actively the sale of electric ranges and water heaters, Holland E. Cox, vice-president in charge of sales, announced at a recent meeting of dealers in the Birmingham district.

The company has not pushed the sale of ranges for the past several years, the cost of installation being considered excessive, especially where customers moved frequently. Also the public was inclined to look upon ranges as "expensive" both as to original cost and as to operation. Mr. Cox explained that these objections have now been cleared away and he predicted quite a volume of sales in these two items, which he said were needed to help complete the electric home.

E. W. Rice, Jr., Bronze Plaque Is Unveiled

First event in the celebration of Schenectady's half century of electrical progress was the renaming of Schenectady's new River Road in honor of the late E. W. Rice, Jr., second president of the General Electric Company. Attending the ceremony were members of the board of directors and leading company officials. At the entrance to the road a huge stone boulder, displaying a bronze plaque briefly describing Mr. Rice's achievements, was unveiled by two of the electrical pioneer's grandsons, who are shown seated atop the boulder.

At the left, in front, are M. P. Rice, brother, and Chester and E. T. Rice, sons of E. W. Rice, Jr. Also in the front row to the left of the boulder are President Gerard Swope, Director Seward Prosser and A. L. Rohrer. In the front row on the other side of the boulder are Dr. W. D. Coolidge, director of the G.E. Research Laboratory; Director and Honorary Vice-President George F. Morrison, Director George P. Gardner, Director Gordon Abbott and Chairman Owen D. Young. In the background, to the left of the boulder, left to right, are J. W. Apperson (second in back of E. T. Rice), Director Bernard E. Sunny, Secretary W. W. Trench, Director Henry S. Morgan, Commercial Vice-President H. H. Barnes, Vice-President C. E. Tullar, Vice-President E. O. Shreve, W. L. R. Emmett; W. S. Barstow, President of Thomas Alva Edison Foundation; Director Clarence M. Woolley, Director Lewis B. Williams and Director and Honorary Vice-President Burton G. Tremaine. To the right of the boulder in the background are, left to right, Vice-President Joseph E. Kewley, Vice-President E. W. Allen, Director and Honorary Vice-President Jesse R. Lovejoy, Director Leon Fraser, A. H. Jackson, Director Francis L. Higginson, S. L. Whitestone and Honorary Vice-President John G. Barry.

A. G. Wishon Passes Away

On Wednesday evening, June 17, A. G. Wishon, pioneer in the electrical development of California's San Joaquin Valley, passed away in Fresno, Calif. Services are to be held at his home this morning. Widely known as a builder and constructor, gifted with great foresight and with the business acumen to join that foresight with far-reaching accomplishment, Mr. Wishon is mourned by a wide circle of business associates and friends.

Mr. Wishon was born at Coppedges Mill, Mo., November 6, 1858. He studied civil engineering at the University of Missouri School of Mines and Metallurgy and went west to Washington in 1888 and then to California in 1889. There he became the leader in the transformation of the San Joaquin Valley into a fertile land of orchards and crops where thousands of families settled.

Years before the transmission of electrical power was considered feasible even over short distances Mr. Wishon had made surveys for water-power development in the High Sierras. Apparently visualizing the acres of gardens which might bloom in San Joaquin, Mr. Wishon labored courageously and persistently to secure the capital necessary for water-power and irrigation development. With the assistance of John Hays Hammond and English capital, in 1898 Mr. Wishon founded the Mount Whitney Power Company, and in 1902 he became associated with Los Angeles capitalists in the purchase of railway, water and power properties in Fresno. This led to the formation of the San Joaquin Light & Power Corporation, of which Mr. Wishon became, successively, general manager, president, chairman of the board and vice-chairman of the board, and, as well, officer of Midland Counties Public Service Corporation. Both companies now are part of the Pacific Gas & Electric family.

Mr. Wishon's career was an outstanding example of vision coupled with a practical knowledge of how to translate that vision into reality. His monument is the verdant San Joaquin Valley of California with its green and purple fields of alfafa, its acres of oranges, lemons, figs, peaches and raisins and its many thousands of contented, prosperous American families.

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Industrial Growth in Associated Areas

The report for 1935 of the industrial development division of the Associated Gas & Electric System shows that 260 new industrial establishments started operations in the areas served by companies of the system. These new concerns employed 9,660 wage earners, and in many instances contributed considerable assistance to smaller communities in solving unemployment and relief. This was somewhat offset by a loss of twenty companies, which moved to areas outside the system; another 81 succumbed to financial difficulties. The total workers employed by these companies was 6,874.

"MAIN STREET" AT PICKWICK LANDING

Wide World

Inside the navigation lock at Pickwick Landing Dam is this "main street." This lock, 53 miles down stream from Wilson, is the country's highest single-lift navigation lock.

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T.V.A. Suggested for Wisconsin

Congressman Thomas O'Malley has proposed to Congress the creation of a vast power and flood control authority on the Wisconsin River, according to the Associated Press. It would be modeled after the Tennessee Valley Authority.

Mr. O'Malley proposed construction of three dams on the Wisconsin River to enable the "Wisconsin Valley Authority" to sell power within a radius of 200 miles of each dam, which would include, in addition to Wisconsin, parts of Michigan, Illinois and Iowa.

One dam on the river, Mr. O'Malley asserted, could serve Milwaukee with power at a much cheaper rate than residents of Milwaukee now are paying. His bill provides for governmental sale of power for distribution through existing private and municipal utilities.

Preliminary surveys show that the Wisconsin River, because of its faster flow, would be better than the Tennessee River for such a project, according to Representative O'Malley. The Wisconsin Valley Authority would be administered by a three-man board of directors.

P.W.A. Cold Storage Plants in Alabama

That section of the Tennessee Valley included in north Alabama may soon have 43 rural cold storage plants to cost $600,000 and constructed with P.W.A. funds, according to an announcement by Judge Orlan B. Hill, Jr., of Florence, Ala.

Construction of these plants has been approved by the state P.W.A. offices, Judge Hill stated, and should P.W.A. funds not be made available, he said the plants could be financed through the Rural Electrification Administration.

By a vote of 176 to 6, citizens of Henderson, Tenn., authorized a bond issue not to exceed $35,000 to finance a distribution system, to be connected to T.V.A. power. Henderson is now being served by West Tennessee Power & Light Company.

Bonds are to be issued by Columbus, Miss., the City Council announces, $1,500 of which will be utilized for a "T.V.A. power survey," the balance for "public improvements."

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President Signs $272,000,000 Flood Bill

President Roosevelt signed this week the Overton bill authorizing $272,000,000 of flood control works in the lower Mississippi Valley. Remaining before him for action was the omnibus flood control bill authorizing expenditure of more than half a billion dollars in many sections of the country, including the East, which was hard hit by floods several months ago.

New Underwriting Procedure for New York Edison Refunding

Morgan Stanley & Company plans innovation designed to facilitate marketing of large issues.

New York Edison Company moves toward completion of another step in its major refunding and merger program by reason of the forthcoming issuance of $30,000,000 of 3¼ per cent series E, first lien and refunding mortgage bonds dated April 1, 1936. A new plan, said to be under consideration by Morgan Stanley & Company, the underwriters, will introduce a degree of flexibility in the offering date which may well allow underwriters better to determine offering price and date of public offering in accordance with market conditions.

Heretofore it has been expected, in financial circles at least, that a public utility issue would be offered on the "effective date" which terminated the S.E.C. twenty-day period of registration. For various business and financial reasons, it has been desirable at times to delay the public offering of a registered issue, with the unfortunate result that an indifferent response came from investors who assigned unsupported reasons to the delay.

The new provisions involve no new rule or regulation by the Securities and Exchange Commission, it was stated in banking circles, as registration and distribution will proceed as usual. However, the innovation will provide a flexibility which will be of advantage to the borrowing company by insuring better "timing" of the issue and perhaps, thereby, a better price. At the same time underwriting organizations will be relieved of the risk of making final commitments for a new issue several days before the effective date. This risk developed from the fact that the principal underwriters have not been free to contract with their sub-underwriters until the underwriting commitment was made and approved.

Officials of the Securities and Exchange Commission, commenting upon the proposed procedure, stated their recognition of the fact that, under less favorable market conditions, difficulties might arise which would be mitigated by more flexible arrangements. Variations from standard practice have been tried out recently, but the new plan seems to be superior.

Under the new system, therefore, effective registration of the New York Edison issue will be in before the underwriting commitment is made and the underwriters, in this case Morgan Stanley & Company, will be enabled to complete sub-underwriting arrangements before making their own final commitment.

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Power Projects Meet Congressional Objections

Four major power projects undertaken originally with P.W.A. funds ran into trouble this week when Congress declined to approve huge appropriation bills for Grand Coulee, Grand Lake, Central Valley and Indian land irrigation projects.

The government's obligation with respect to Grand Coulee would be limited to $63,000,000 and upsets Administrator Ickes's plans for a higher dam estimated to cost at least $200,000,000.

The House refused to approve $268,000,000, which included a new "Grand Lake Project" which would tunnel the Colorado Rockies to move water across the Great Divide for land reclamation. The conference bill also eliminated $16,000,000 provided in the Senate bill for the Central Valley project in California (see ELECTRICAL WORLD, May 16, 1936, page 6), with present contractual obligations of the government provided for in the deficiency appropriation bill.

Finally a Senate proposal of $3,710,000 for irrigation projects on Indian lands was reduced to $880,000.

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P. W. A. Celebrates Third Birthday

Tuesday marked the third anniversary of the Public Works Administration and Administrator Harold L. Ickes reviewed the constructive activities undertaken by P.W.A., and asserted: "The same established policies and methods of administration that have prevailed in the past three years will continue in the future. P.W.A. will not fail to give the country its best."

Almost three billion dollars have been expended by P.W.A. during the past three years, and Administrator Ickes estimates that employment created thereby has amounted to 5,801,000 man-years, which includes indirect as well as direct employment.

The extreme diversity of 21,000 projects which benefited from P.W.A. funds was brought to mind by the Administrator's review of the three years' operations. Large outlays for naval vessels, army housing, stream-lined, Diesel-electric trains, rivers and harbors, federal-aid highways, etc., were among the P.W.A. projects, and in contending that P.W.A. projects are useful, the Administrator selected such non-competitive projects as New York's Triborough Bridge, a school-house at Lyme, Conn., a disposal plant at Lumpkin, Ga.

P.W.A. is currently engaged in giving to state and local agencies approximately three hundred million dollars which heretofore has constituted its revolving fund. Such gifts are expected to average $1,000,000 per day.

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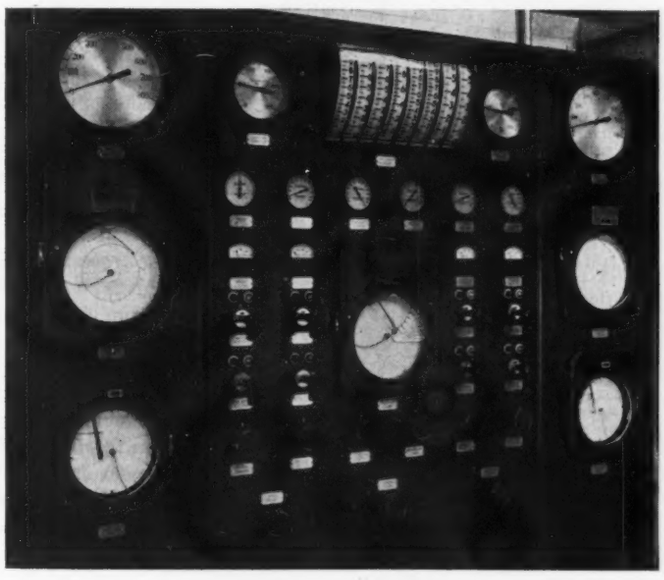
Trumbull Electric To Build Addition

Trumbull Electric Manufacturing Company, Plainville, Conn., has awarded a general contract to the Austin Company, Cleveland, Ohio, for a new one-story addition to branch plant at Ludlow, Ky., for which superstructure will begin at once. It will cost about $50,000.

MAIN CONTROL PANEL AT SPRINGFIELD

Panel at Springfield, Ill., new million-dollar municipal power plant placed in operation three weeks ago. This is a benchboard type panel with Westinghouse "Minatrol" switches and flush type meters.



El Paso Ruling Enjoins Labor Board

Ruling that the National Labor Relations Act was unconstitutional in its entirety, Federal Judge Charles A. Boynton of the West Texas District granted last week an application of the El Paso Electric Company, a Stone & Webster subsidiary, for a permanent injunction against the members of the National Labor Relations Board at Washington.

The injunction prevents this board or any of its representatives from proceeding with a hearing on charges of unfair labor practices filed by Local 585, International Brotherhood of Electrical Workers, who went on strike last February for a second time after failure to negotiate a contract with the power company.

Judge Boynton held that the company had shown irreparable damage; that Congress exceeded its power in enacting the Wagner law under the Interstate Commerce clause, the commerce clause or any other clause of the Constitution. He said that the act was in violation of the Tenth and Fifth Amendments.

He further held that the El Paso Electric Company was engaged in local rather than interstate commerce; that creation of electric energy was one act and transmission across state lines another.

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Preferred Practice for Graphic Presentation

Under this title the A.S.M.E. has published a draft of a code of practice in the construction of time-series charts, prepared for the guidance of designers of such charts by a subcommittee of the Sectional Committee on Standards for Graphic Presentation. The booklet contains a discussion of features that go into the making of effective graphical presentations, such as relative dimensions, choice of scales, weight of lines, economical degree of accuracy, titles, labels, lettering and others.

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Farm Service Demands Energetic Cultivation

That "any old salesman" cannot sell electric service to farmers and that rural electrification progress requires co-operation between utilities and all other agencies working for the betterment of country life featured an address last week at the spring conference of northeastern farm bureau officials in Amherst, Mass., by Prof. W. T. Ackerman, head of the agricultural engineering department, University of New Hampshire, Durham. Professor Ackerman, who has long been identified with New England rural electrification advances, declared that the outstanding problem is how much energy the average farm will eventually use.

"Rural America is going to have electric service—somehow," he said. Yardsticks applied to farm service should not be too rigid, as closer study of economic requirements indicates that the problem is less difficult than at first appeared. Low "objective" rates, a liberal outlook on extensions with reasonable consideration of costs, load building through the employment and support of rural service engineers, and team-play with other organizations offer all concerned avenues toward more profitable use of electricity in rural areas, the speaker concluded.

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Winnipeg Electric Sale Off

Negotiations for the sale of the Winnipeg Electric Company to the city of Winnipeg have been discontinued, said Edward Anderson, K. C., president, in addressing the recent annual meeting of shareholders of the company. Financial reorganization had saved the company from bankruptcy and, while strict economy still was necessary, the outlook was brighter, Mr. Anderson said. Shareholders elected six directors and bondholders appointed six. At the directors' meeting it was announced that interest at 4 per cent would be paid for 1935 on the company's general mortgage bonds and debenture stock, series "B."

COMING MEETINGS

International Union of Producers and Distributors of Electric Energy—Sixth congress, Scheveningen, Holland, June 10-20.

American Institute of Electrical Engineers—Summer convention, Huntington Hotel, Pasadena, Calif., June 22-26. H. H. Henline, national secretary, 33 West 39th Street, New York.

Society for the Promotion of Engineering Education—Annual meeting, University of Wisconsin, Madison, June 23-26. Dr. F. L. Bishop, University of Pittsburgh, Pittsburgh, Pa.

Canadian Electrical Association—Annual convention, Murray Bay, Quebec, June 24-26. B. C. Fairchild, secretary, Power Building, Montreal, Que.

American Society for Testing Materials—Annual meeting, Chalfonte-Haddon Hall, Atlantic City, June 29-July 3. R. E. Hess, assistant secretary, 260 South Broad St., Philadelphia, Pa.

Illuminating Engineering Society—Annual convention, Statler Hotel, Buffalo, N. Y., August 31-September 3. A. D. Cameron, general secretary, 29 West 39th Street, New York.

Third World Power Conference—Washington, D. C., September 7-12. Joel Wolfsohn, executive secretary, Interior Building, Washington, D. C.

International Association of Electrical Inspectors—Eastern section, Hotel New Yorker, New York, September 8-10; Northwestern section, Olympian Hotel, Olympia, Wash., September 14-16.

National Electrical and Radio Exposition—Grand Central Palace, New York, N. Y., September 9-19. Ralph Neumuller, secretary, 480 Lexington Avenue, New York, N. Y.

Rocky Mountain Electrical Association—Annual convention, Santa Fe, N. M., September 21-23. George E. Lewis, managing director, Gas and Electric Building, Denver, Colo.

Association of Iron and Steel Electrical Engineers—Annual convention, Detroit, Mich., September 22-25. Brent Wiley, managing director, Empire Building, Pittsburgh, Pa.

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Carolina Utility Plans Expansion

Details of an improvement and expansion program, including the construction of a new substation, of the distribution system facilities of the Carolina Power & Light Company in Raleigh and the vicinity have been announced by company officials.

Work on the program is being pushed forward rapidly and officials estimated that the various jobs would be completed in the early fall. A number of electrical and construction men have been added to the company's regular force to rush the work.

Major item in the program is the construction of the new substation, which will be equipped with a capacity of 6,700 hp. The capacity of all the company's substations in the city is being increased and additional equipment is being provided for the Method substation.

In addition to increasing capacities, considerable work is being done on the downtown distribution lines to allow for increasing demands in the commercial area.

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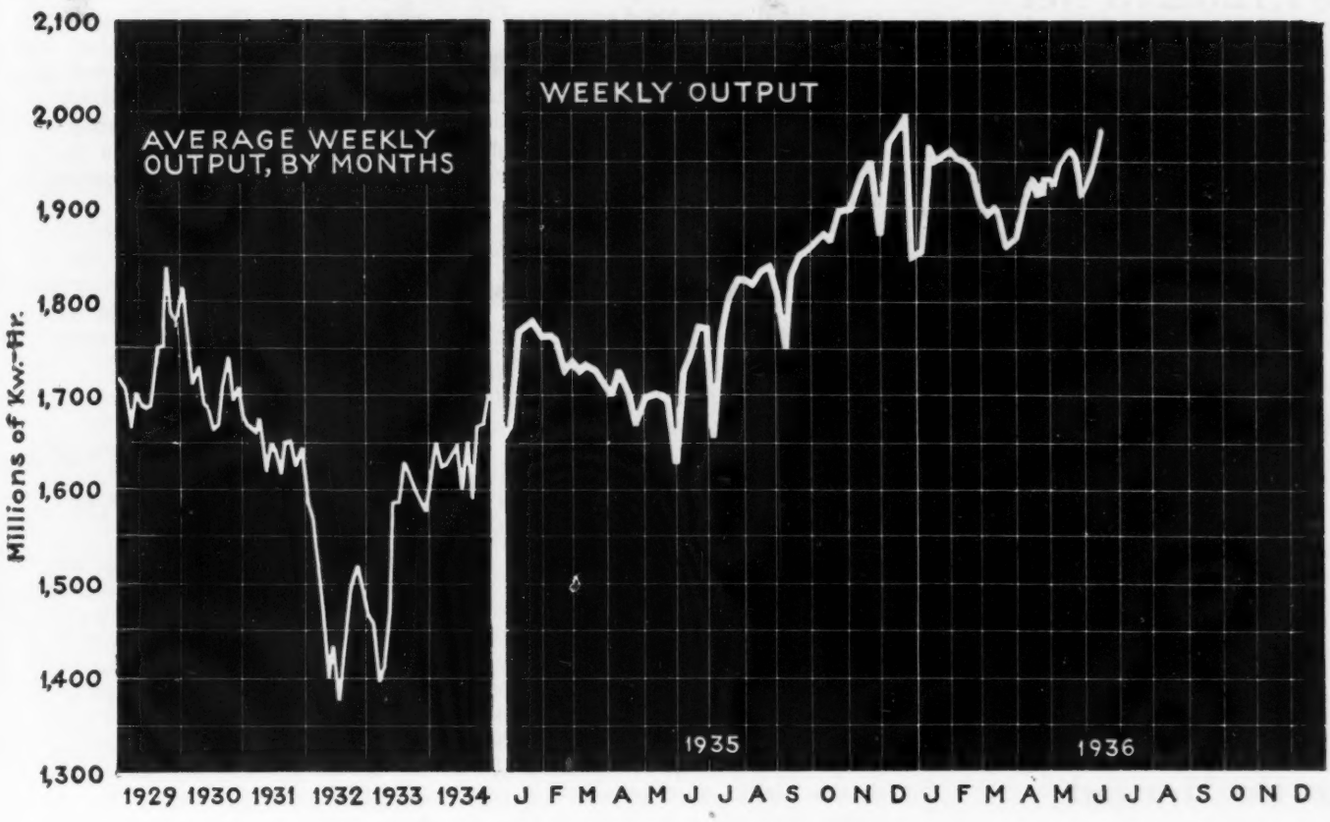
Nebraska Adopts New Rural Charges

The Iowa-Nebraska Light & Power Company of Lincoln, Neb., has adopted a rural electrification policy whereby it will build rural lines wherever it can obtain an average of two customers to the mile provided it can obtain the necessary right-of-way. The company agrees to construct, maintain and operate a line extension, including transformer and meter, to supply single-phase electric service for the customers' use. It will build the service line two spans from the power line, the customer to pay for additional spans.

The rates adopted by the company for this type of service are: $4.50 a month minimum, which includes 50 kw.-hr.; 4 cents per kilowatt-hour for the next 50, 3 cents for the next 100 and 2 cents each for all in excess of 200.

The company has recently received permission to build 175 miles of rural line in Lancaster County and construction is now under way. Company solicitors are signing up farmers in the territory the line covers.

Output Sets New 1936 Record



Surpassing the figures for any previous week in 1936 and missing last winter's all-time December peak by only a fraction of one per cent, the output of electric light and power plants in the week ended June 13 rose to 1,989,798,000 kw.-hr., according to the Edison Electric Institute. This was about 45,000,000 kw.-hr. more than in the preceding week and indicates a gain of 14.2 per cent over the like period in 1935. It occurred at a time when the summer valley is normally to be expected in the output curve.

The insistent upward trend, now sharply emphasized, which has been in evidence since the latter part of March, can be interpreted only as an indication of a rising demand for energy for industrial purposes supplemented by the increasing use of domestic appliances.

In the Central industrial area the average gain over last year has lately been close to 20 per cent and in the Mountain states somewhat higher. It was lowest on the Pacific coast.

Per Cent Change from Previous Year

	Week ended		
	June 13	June 6	May 30
New England.....	+14.5	+12.7	+18.7
Middle Atlantic....	+11.1	+ 8.1	+13.4
Central Industrial...	+20.3	+16.3	+21.7
West Central.....	+14.0	+14.9	+18.3
Southern States....	+17.0	+15.5	+20.4
Rocky Mountain...	+17.5	+18.9	+22.8
Pacific Coast.....	+ 6.7	+ 4.6	+11.9
United States....	+14.2	+12.8	+18.0

Weekly Output, Millions of Kw.Hr.

1936	1935	1934
June 13...1,990	June 15...1,743	June 16...1,665
June 6...1,945	June 8...1,724	June 9...1,655
May 30...1,922	June 1...1,629	June 2...1,576
May 23...1,955	May 25...1,696	May 26...1,655
May 16...1,962	May 18...1,700	May 19...1,650
May 9...1,948	May 11...1,702	May 12...1,643

Power Act Ruled Valid by Ontario Court

Chief Justice Rose has dismissed action of the Ottawa Valley Power Company, which sought a ruling that the Ontario government act of 1935, terminating power contracts with the company and the Ontario Hydro-Electric Power Commission, was void and unenforceable.

In April, 1935, a bill stating power contracts between the commission and the Ottawa Valley utility and other Quebec companies to be illegal and unenforceable became law. In January, 1936, Ottawa Valley Company launched its action against the commission and others, declaring the act to be *ultra vires* and the power contracts binding. The decision upholds the act and denies the company's claim.

The utility's appeal against the judgment of Chief Justice Rose will be heard in September. Before the Court of Appeals counsel involved in the case agreed to expedite the case and W. N. Tilley, K. C., power company counsel, withdrew his motion to have the appeal heard at once.

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Traveling Exhibit Plans Launched

Consolidated Gas, Electric Light & Power Company of Baltimore, through its president, Herbert A. Wagner, has announced that it will contribute $10,000 a year for three years to a fund which will be raised by the Maryland Academy of Sciences to arrange for a traveling industrial and educational exhibit. The plan was launched at a meeting held at Baltimore on May 25 and at which Mr. Wagner, who also is president of the academy, presided. Letters indorsing the plan were received from many leaders in industry and science, including Gerard Swope, Owen D. Young, Lamont duPont, T. O. Richardson and Rufus C. Dawes.

The plan also was indorsed by Frank B. Jewett, president of the New York Museum of Science and Industry, who attended the meeting. In order to carry out the plan, a fund of $55,667 will have to be raised each year for a period of three years.

Associated Reports $4,725,273 Net

Preliminary condensed annual report of the Associated Gas & Electric Corporation for 1935 shows consolidated gross revenues, including new properties only from their date of acquisition, amounting to $93,215,717, compared to $83,973,089 for 1934. Operating income after expenses, taxes and reserves was $27,033,265, against $25,183,469 in 1934.

Net income was $4,725,273 compared to $5,880,983. The report says that under the plan of rearrangement of debt capitalization of the Associated Gas & Electric Company, more than $194,000,000 debentures of that company have been exchanged for debentures of the Associated Gas & Electric Corporation.

The new-business department during 1935 obtained business estimated to produce revenues of $7,536,027, an increase of 41.3 per cent over 1934, J. I. Mange, president, said in the report. Extensions and improvements cost subsidiaries of the corporation $11,100,000 last year.

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Consolidated Units to Be Merged

Application was filed last week with the New York Public Service Commission for permission to merge the Yonkers Electric Light & Power Company and the Brush Electric Illuminating Company of New York into the New York Edison Company, Inc., which owns 100 per cent of their stock. These companies are all units in the Consolidated Edison system. The application is a preliminary phase of the proceedings by which all the operating utilities in the group are expected to be merged into Consolidated Edison Company of New York.

The application stated that the merger would not involve any issue of new stock or other securities and the books on completion of the merger would reflect consolidated or combined accounts of the two companies.

An application also has been filed with the commission by the Brooklyn Edison Company, Inc., asking permission to merge with the Amsterdam Electric Light, Heat & Power Company, its wholly owned subsidiary.

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S.E.C. Registrations

Otter Tail Power Company, Fergus Falls, Minn., has filed a registration statement with the S.E.C. for $3,000,000 of 4 per cent first mortgage bonds, due 1961, and $600,000 of 3 per cent secured notes due 1941. Proceeds from the sale of the securities will be used to retire the entire outstanding funded debt of the company.

American Cities Power & Light Corporation of Jersey City, N. J., an investment trust, has filed with the commission a statement covering 150,000 shares of $25 par value class A stock, optional dividend series of 1936, with attached warrants for purchase of common stock of the North American Company. The class A stock being registered will constitute a new series of the serial class A stock of the corporation, of which 154,222 shares are now outstanding. The stock purchase warrants for shares of common stock of the North American Company will entitle the holders to purchase 150,000 shares.

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Narragansett Electric Calls Bonds

Calling of $33,155,500 bonds is announced by Narragansett Electric Company, subsidiary of New England Power Association. The bonds, which are first mortgage liens, are in three series, A, B and C. New notes, according to a statement recently filed with the S.E.C., will be issued under a credit agreement with certain banks. The note issue, which represents temporary financing and which probably will be followed at a later date by a long-term bond issue to replace the notes, is the first step in a refunding program undertaken by the company for the purpose of lowering its interest costs.

Samuel C. Moore, president of the company, stated recently that the savings effected in interest charges by such a move would make it possible for the company to reduce rates to consumers.

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N. H. Public Service Absorbs N. H. Power

Approval has been granted by the Securities and Exchange Commission of an application by the Public Service Company of New Hampshire to acquire securities giving it control of New Hampshire Power Company under provisions of the Public Utility Holding Company Act of 1935. The securities consist of (1) all of the common stock (5,214 shares) without par value; (2) 1,800 shares of 8 per cent cumulative preferred stock (par value $100), comprising approximately 46 per cent of the preferred stock outstanding; (3) $100,000 principal amount of first mortgage 6 per cent sinking fund gold bonds maturing December 1, 1943, of which $724,000 principal amount is outstanding.

The securities are to be acquired for cash in the amount of $697,000 to be raised through temporary bank loans at a low rate of interest. The securities are now owned by the Middle West Corporation and Electrical Securities Corporation in equal proportions, with a minor exception.

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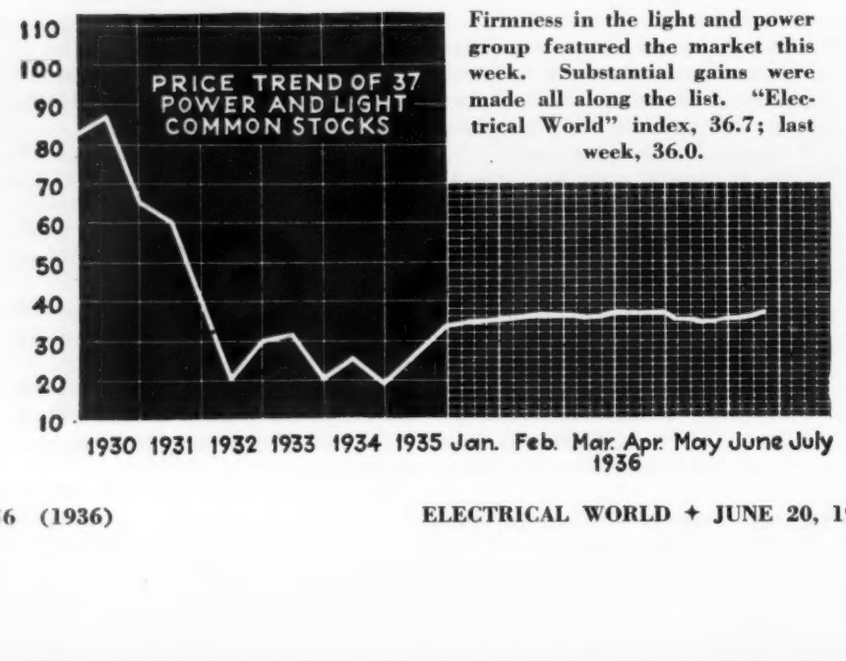
Utility Stocks Swing Upward



Firmness in the light and power group featured the market this week. Substantial gains were made all along the list. "Electrical World" index, 36.7; last week, 36.0.

Wisconsin Utility Wins Exemption from S.E.C.

An order exempting the Wisconsin Public Service Corporation from provisions of the Public Utility Holding Company Act was issued last week by the S.E.C. In the statement covering the exemption the commission said that it had found that the applicant has one public utility subsidiary, Menominee & Marinette Light & Traction Company, an electric and gas utility organized under the laws of Wisconsin and Michigan, and that the applicant is predominantly a public utility company whose operations as such do not extend beyond the state of Wisconsin, in which it is organized, and states contiguous thereto.

MANUFACTURING AND MARKETS

Giant Motors Bought for Pumping Plants

Fifteen giant electric motors which are to drive the pumps that will lift Colorado River water 1,600 ft. on its journey between the river and the Coastal plain have been purchased by the Metropolitan Water District of Southern California for a total price of $1,766,721. This order, authorized by the Water District board of directors subject to the approval of the Reconstruction Finance Corporation, is said to be the largest of its kind ever placed. Having a total horsepower of 142,000, the fifteen electrical motors will operate at 6,900 volts. Each motor installation will measure approximately 12 ft. high and from 9 to 14 ft. in diameter.

The purchases approved by the Water District board were as follows:

Six 9,000-hp. motors for the Gene and Intake pumping plants on the aqueduct, from the General Electric Company for $693,759.

Three 4,300-hp. motors for the Iron Mountain pumping plant, from the Allis-Chalmers Manufacturing Company for $288,400.

Six 12,500-hp. motors for the Eagle and Hayfield plants, from the Westinghouse Electric & Manufacturing Company for $784,562.

The fifteen huge units are to be operated with electrical energy generated at Boulder Dam. The Metropolitan Water District is now building a 237-mile, 230,000-volt transmission line, linking the five aqueduct pumping plants with the power house at the dam.

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Dayton League Stages Show

The Electric League of Dayton, Ohio, is staging one of the biggest co-operative sales promotion programs ever presented to the public in that city. The program, which opened June 16 and will continue until June 27, will include an "Electrical Refrigerator Parade."

The principal purpose of the sales campaign is to induce former World War veterans to use a portion of their new bonus money for electric refrigerators. A feature of the campaign will be a letter writing contest on the subject "Why I Want a 1936 Electric Refrigerator," which is not to be more than 50 words long. First prize winner will receive $50 in cash, with $25 going to second place and $10 to third. Fifteen $1 prizes will also be given. Employees of wholesale or retail electric refrigeration organizations within the city are not eligible to compete.

Four double-truck advertisements will appear in two evening newspapers during the campaign the cost of which is prorated among the members of the league. In addition retailers will also carry their own individual advertisements. Newspapers are co-operating by tying in with newspaper stories on electric refrigerators and the letter-writing contest. All dealers have been urged to use attractive window displays during the sales campaign.

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Information on Air Conditioning

"Condensed List of Sources of Information on Air Conditioning" is the title of a sixteen-page publication issued by the Electrical Division, Bureau of Foreign and Domestic Commerce.

This reference list should prove useful to manufacturers and installers of air-conditioning equipment, to engineers and to the sales promotion departments of utilities, as well as to others concerned with that field. The scope of the references is indicated by the section headings, which include government reports on air conditioning, cold storage and refrigeration; trade associations, institutes, societies interested in air conditioning; trade magazines; foreign magazines (British); addresses, books, pamphlets and releases on air conditioning; sources of statistical information on air conditioning.

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Refrigerator Makers See Better Business

The Refrigerating Machinery Association opened its recent spring meeting in Hot Springs, Va., with the largest attendance of manufacturers ever recorded. In calling the meeting to order, D. Norris Benedict, president of the association and vice-president and general manager of the Frick Company, Inc., Waynesboro, Pa., voiced what appeared to be the unanimous feeling of the refrigerating machinery manufacturers that the past year had shown a decided improvement in business conditions, which has been reflected in increased sales of refrigerating machinery. "The improvement has been particularly noticeable since the passing of NRA," Mr. Benedict said, "and I am sure that if business is not smothered by the increasing burden of taxation the business upturn will continue and the return of prosperity will be assured."

Willis H. Carrier, chairman of the board, Carrier Engineering Corporation, who had just returned from a trip around

MR. HUGHES PRESENTS HIS 1936 AWARD

James Wright, commercial manager Kingsport Utilities, Kingsport, Tenn.; Carl Thornburg, general manager, also Kingsport Utilities, and George A. Hughes, president Edison General Electric Appliance Company, Inc., of Chicago. A check for $1,000 accompanied the trophy.

the world, spoke of business conditions as he had encountered them in his travels.

Great interest was manifested in the progress of the broad standardization program which has been carried on by the association during the past year under the leadership of S. E. Lauer, vice-president of the York Ice Machinery Corporation and chairman of the association's standards committee. John W. O'Leary, president of Machinery and Allied Products Institute and formerly president of the U. S. Chamber of Commerce, was the guest speaker and discussed briefly the national political and economic outlook so far as it concerned business men, and particularly those engaged in the manufacture and sale of durable goods.

•

Square D Dividends

An initial dividend of 12½ cents on the new class B stock and the regular quarterly dividend of 55 cents, both payable on June 30 to holders of record of June 20, have been declared by the Square D Company. In the previous quarter a dividend of 25 cents and an extra dividend of 10 cents were paid on the class B. This stock has since been split three for one.

In announcing the dividend F. W. Magin, president, said sales were continuing at a satisfactory rate at all the plants and that the dissolution of the company in California as well as the Square D Company of Texas, and the merging of these operations with the parent company, had proved advantageous.

•

Westinghouse Plans $60,000 Addition

As part of its expansion program in the manufacture of refrigerator units, the East Springfield plant of the Westinghouse Electric & Manufacturing Company will build an addition at a cost of approximately $60,000 to its "Q" building. The building, to be constructed of steel, brick, steel sash and concrete floors, will be completed late this summer or early in the fall. The annex will be 300 ft. long and about 40 ft. wide, one story tall.

New York Metal Prices

	June 10, 1936 Cents per Pound	June 17, 1936 Cents per Pound
Copper electrolytic	9.50*	9.50*
Lead. Am. S. & R. price	4.60	4.60
Antimony	12.125	11.50
Nickel ingot	35.00	35.00
Zinc spot	5.275	5.275
Tin Straits	42.125	42.125
Aluminum, 99 per cent	19—21	19—21

*Delivered Connecticut Valley.

Field Reports on Business

Reports to ELECTRICAL WORLD *from the field indicate that business has been little awed by tax terrors and political powwows. Business statistics presage little recession before middle of next month—some hope it won't come that early. Utility stocks have many friends in the market just now; reflecting the hope that there may be a new administration in Washington next year, ending federal competition.*

NEW ENGLAND

The demand for electrical equipment during the past week throughout this district was moderately active and marked by a considerable diversification in orders. Power equipment orders were confined to small motors in single or small lots, typical orders ranging under $1,000 each; fractional-horsepower motor sales are steady and switch and control apparatus sales continue in good volume. Central station supplies are spotty; pole replacements on some distribution lines have accounted for some buying of these and also of crossarms; outdoor meter sales are encouraging and for the first half year, according to a representative of a well-known company, are in considerable advance over the volume sold for the first half of last year.

Interest in arc-welding equipment is quite strong in this district due to the great variety of products which can be easily assembled by means of this kind of apparatus; a prominent fence manufacturing company recently added another 300-amp. unit; another 300-amp. machine was lately sold to a manufacturing company; negotiations are under way for a number of other units.

Orders for six new 600-hp. Diesel-electric switching engines have been placed by the Boston & Maine Railroad and the Portland Terminal Company. The East Springfield, Mass., plant of the Westinghouse Electric & Manufacturing Company will soon close bids for a new concrete addition to its "Q" building, measuring 300 x 40 ft., in anticipation of a greater demand for refrigerator units in the fall.

PACIFIC COAST

All electrical branches report excellent business, though a comparative dearth of large building jobs has produced complaints from smaller contractors of invasion of their particular field owing to prevalence of residence and small apartment building. Wholesalers report shortages of various lower sizes of rubber-covered wire due to recent 5 per cent advance, which, being widely heralded, resulted in a surprisingly large volume of stock orders.

Bonus distribution will stimulate sale of appliances, particularly refrigerators, but estimates of its direct proportion to electrical business average about 10 per cent of its total volume. Power company construction included several sub-standard extensions to sparsely settled areas and to isolated mines converted from steam. Industrial business includes a flock of small individual drive motors for oil refining plant at Richmond and a projected $2,000,000 sugar plant near Woodland. A previous plant of this character at Hamilton City resulted in much additional motor business from contributing growers.

California's Central Valley water project, originally planned to overcome unequal rainfall distribution and irrigation demand and afterward extended to include a power system, is reported held up by lack of appropriation. San Francisco's Exposition construction is being concentrated on its administration building on whose completion it will automatically qualify for certain federal grants.

Electrical apparatus sales include some large specialized orders in addition to usual seasonal run of pumping motors and extension transformers, such as two $10,000 elevator equipments, a $15,000 dredge, a 4,000-kva. dredge for the government and several large welding equipments, 26 stock sizes having been sold in San Jose area alone this year. Appliance firms are featuring ironer schools, with a two-million-dollar volume predicted in California for 1936, based on a 50 per cent increase over 1935, which showed the same over 1934.

CHICAGO

Each week for five weeks business has edged higher and at present has attained the best showing since 1930, with the exception of the 1935 year-end. Even the most optimistic have failed to estimate the "staying quality" of the movement and now some are prepared for a correction that may go beyond what was visualized as due several weeks back. Some informed quarters assert that much of the contra-seasonal gain recently realized occurred in anticipation of bonus expenditures. At present the business situation is 20 per cent better than in 1935.

Several major industries in Chicago recorded further increases in employment last week. Retail trade displayed some hesitancy, the volume holding on a par with the preceding week. Freight traffic expanded to a new 1936 high. Chicago electric power declined seasonally. Building construction in this area continues to expand as new projects announced include two theaters, several industrial plants and numerous residences.

One manufacturer of electrical equipment reports a sales increase of 40 per cent over last year. Air conditioning is more active and appliance sales continue to show substantial gains. Proposals were made for the installation of several vehicle-actuated traffic control signals. Orders reported include 600 street-lighting reflectors and five 600-amp. oil circuit breakers.

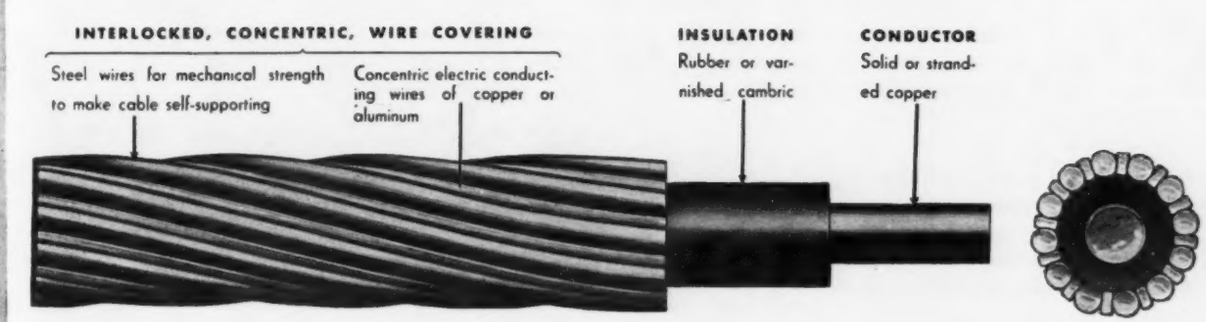
NEW YORK

It begins to look as though there wouldn't be any summer lull in business until after the end of the second quarter. Leading indicators at the moment show no further tendency toward recession—in fact, the latest report on electric energy production shows another good gain to 1,989,798,000 kw.-hr., in contrast to the 1,922,108,000 a fortnight ago, while the margin of gain over a year ago has been stepped up to 14.2 per cent.

Steel production is another index which is going up against the normal trend at this season, with present operations above 70 per cent and mill facilities booked to 100 per cent well into July in some lines. Automobile output, to be sure, has dipped, but no more than was expected; car loadings continue at or near the year's tops; railroad and public utility earnings for April and May make the best comparisons in years.

All indications are that residential and general construction are continuing their strong gains, which sustains the favorable outlook for many types of electrical equipment.

NEW SELF-SUPPORTING TYPE SS AERIAL CABLE


INTERLOCKED, CONCENTRIC, WIRE COVERING
Steel wires for mechanical strength to make cable self-supporting
Concentric electric conducting wires of copper or aluminum
INSULATION
Rubber or varnished cambric
CONDUCTOR
Solid or stranded copper

SAVE by its use on urban, suburban, and rural circuits . . . for both primary and secondary distribution . . . instead of bare, weatherproof, or tree wire; or insulated cable on messengers.

Reasons: lower-cost installation and maintenance . . . better electric characteristics . . . improved continuity of service . . . greater safety.

AN armor of steel wires interlocked with electric conducting wires makes G-E Type SS aerial cable self-supporting.

Advantages: Fastened to poles by inexpensive methods; eliminates crossarms, pins, and insulators; reduces amount of other accessory equipment. Permits joint use of poles with telephone lines. Does away with tree trimming. Needs no messenger.

Strong, can stand excessive wind, ice, and sleet loads. Bulletproof. High tensile, abrasive, and dielectric strength minimizes the probability of mechanical or electrical failure. Bare-neutral ground-return conductor is close to other conductor—thus the cable provides better regulation than open-wire construction.

Check these and other advantages in the use of G-E Type SS cable for your overhead lines. Details are given in Bulletin GEA-2408. For a copy address nearest G-E sales office, or General Electric, Dept. 6A-201, Schenectady, N. Y.

520-73

GENERAL ELECTRIC

FIELD OPERATING PRACTICES

New ideas and practices in the operation of well-designed, constructed and maintained plants and systems

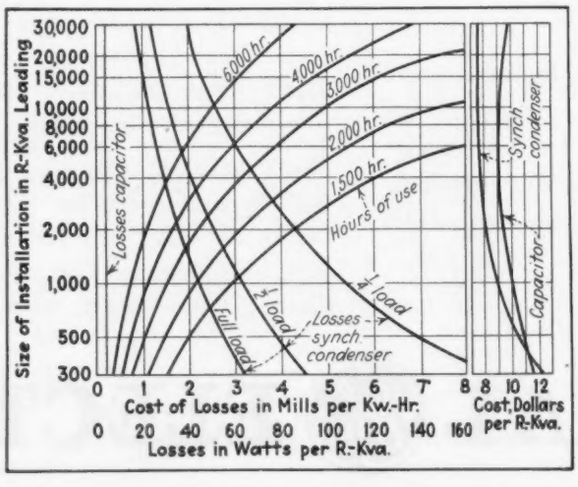
Capacitors Advocated for Medium Cases

By A. A. BOLSTERLI
Products Protection Corporation,
New Haven, Conn.

Installed cost of large capacitor groups is no longer materially higher than that of synchronous condensers. On the operating cost side the capacitor has a large advantage in that its losses are only a fraction of those of the corresponding synchronous condensers, and that, moreover, the percentage losses do not increase at fractional loads. Comparative losses are represented in the graph attached.

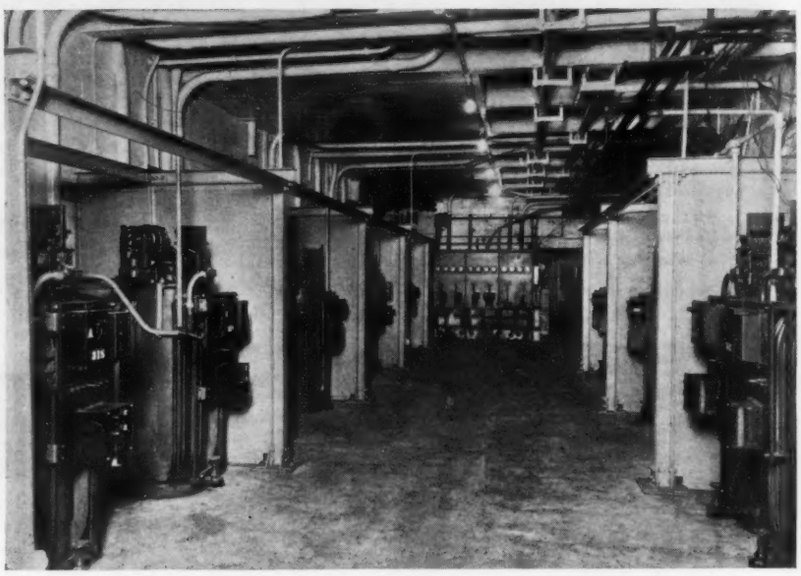
Since operation of capacitors is equally economical for small as well as for large groups, the percentage losses being independent of size, and since cost per kva. depends but slightly upon size, the necessity of lumping capacity in one point to obtain lower first cost and better efficiency does not exist.

The relative economy of capacitor groups versus synchronous condensers is governed largely by the hours of use and the cost of power for the losses, whereby limited hours of use and low cost of power tend to favor the synchronous condenser, and vice versa. For average conditions the attached graph was obtained, by means of which it is possible to determine at a glance whether a synchronous condenser or capacitor installation is more economical for a given cost of power and assumed hours of operation.



Appropriate fields for capacitors and synchronous condensers

Each of the curves marked "Hours of Use" represents a condition of approximate economical balance in annual cost on the basis of 15 per cent for interest, depreciation and taxes and 3 per cent for maintenance. The field to the right of each curve belongs to the capacitor, that to the left to the synchronous condenser.



Rearrangement of regulators clears operating space

Modernizing a Regulator Room

By transferring two rows of 2,300-volt feeder regulators formerly placed back to back along the longitudinal axis of a room assigned for this service, the Worcester (Mass.) Electric Light Company greatly improved operating conditions in its Webster Street generating station. The regulators were placed at the sides of the room in open steel-paneled compartments, and the former overhead open wiring which had blocked convenient access to the regulators above the units was rerun in conduit, carried along the ceiling to the individual compartments and dropped to the units as shown. In the former arrangement the regulators could not be disconnected from the feeders without cutting the conductors open beyond the regulator units, but in the new set-up both regulator and associated oil circuit breaker can be cut free for repairs by opening disconnecting switches between the station bus and the breaker and between the regulator and the feeder.

Formerly the regulators were water-cooled and were reached by walkways parallel to the two rows. Now they are oil-cooled and a 7-ft. aisle has been cleared by the rearrangement. Two phases of each circuit are equipped with a regulator and the units are paired in the compartments, all steel paneling being grounded. Ten 100-watt lamps with "Holophane" reflectors have since been installed for general lighting, the room being about 11 ft. high by approximately 50 ft. long. The walls were painted white to improve the light distribution. Only 1 deg. F. of temperature difference exists between the compartment interior corners and the center aisle. Two fans are used at either end of the regulator room to improve circulation in hot weather.

HOW ONE POWER COMPANY SAVES $5000 A YEAR ON BREAKER MAINTENANCE

TWO and one-half years ago, the Carolina Power & Light Company modernized 19 of its G-E high-voltage outdoor oil circuit breakers by installing oil-blast parts. Since that time, this Company reports a realized annual saving of $5000 on the upkeep of these old breakers. • This saving results largely from the more positive and rapid arc extinction obtained from the oil-blast contacts. Inspection and re-dressing of contacts becomes almost unnecessary. Oil carbonization is so slight that the oil remains in good condition for long periods.

More information on the results accomplished by this operating company through modernizing its old breakers to improve service and reduce maintenance is given in an article by J. H. Paget, Manager Engineering and Operation, in the ELECTRICAL WORLD for February 29, page 78.

Other Benefits

The operating speed of the breakers was stepped up from 25 cycles to 8 cycles; out-of-step conditions previously present have been virtually eliminated. Maintenance on transmission-line conductors necessitated by burning has been practically obviated. The system disturbance from faults has been greatly reduced, resulting in improved service and better-satisfied customers. Why not investigate the profitable possibilities of modernizing your oil circuit breakers? General Electric, Schenectady, N.Y.

890-3

GENERAL ELECTRIC

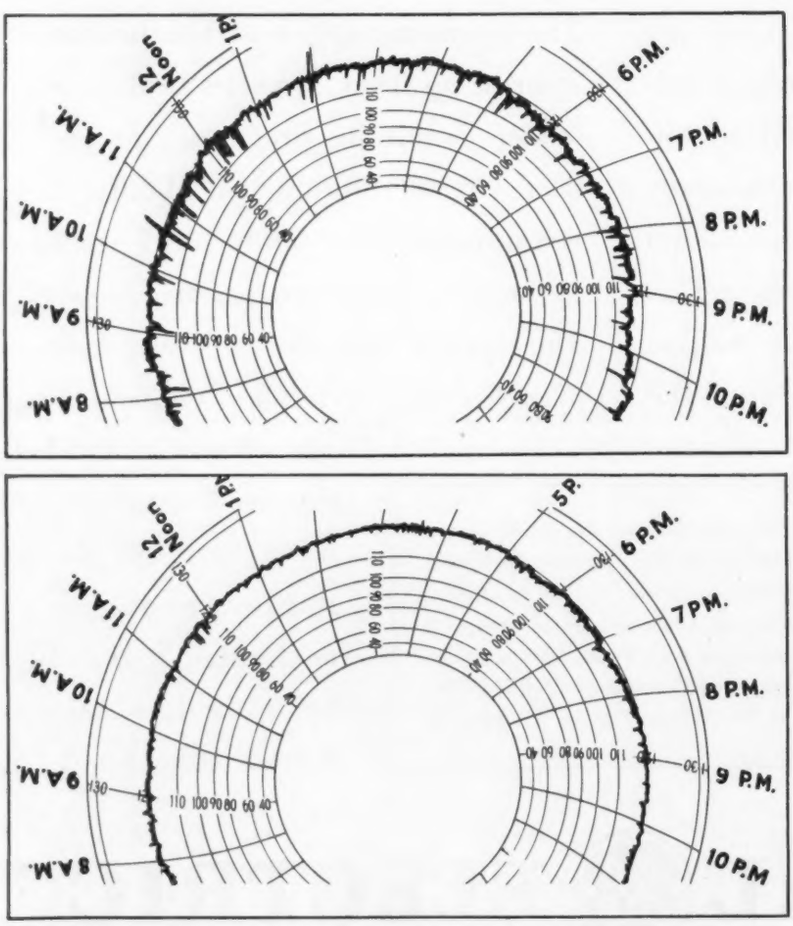
Auto-Transformer Solves Problem

By E. R. DANIELS
Electrical Department,
Pacific Gas & Electric Company

Balancing auto-transformers may be very effective in correcting voltage fluctuations where variable low-power-factor loads located several spans from a transformer are served with 120-240-volt, three-wire secondaries. The simplicity and relative economy of this method offers relief from the ever-increasing regulation problem presented by motor-driven appliances.

In one case of voltage complaint the customer was four spans away from a 25-kw. transformer, and a 24-hour record indicated frequent voltage swings due to a refrigerator, some as high as 10 volts, with many averaging 5 or 6 volts. The intervening secondary consisted of one span of No. 1/0 and a neutral of No. 4 and three spans of No. 4 with a No. 6 neutral. Changing the wire size in the last three spans of No. 2 with a No. 4 neutral and increasing the service drop from No. 8 to No. 6 did not help much.

Then a 2-kva., 240-120-volt balancing auto-transformer was connected across the three-wire secondaries on the pole nearest the customer. Another 24-hour record showed only minor fluctuations averaging 2 or 3 volts, with a few around 4 volts.



Voltage regulation before and after applying auto-transformer

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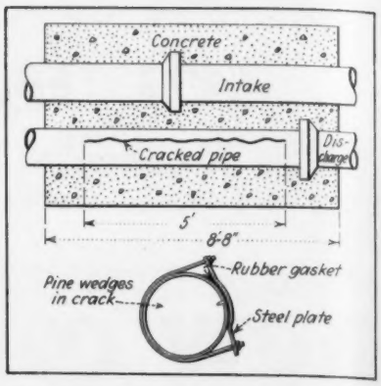
Water Line Repaired Without Shut-down

By C. E. CUSHING
Northern States Power Company,
Minot, N. D.

Formation of puddles on the ground outside the Minot, N. D., plant of the Northern States Power Company led to the disclosure below of a 5-ft. crack in the discharge line of the circulating water system. A new section of pipe could not be installed without shutting down the plant. Repairs had to be made to keep running.

A piece of sheet steel a little longer than the crack and somewhat wider than the pipe diameter was bent, as illustrated, to conform to the pipe curvature. A series of twelve U-bolts to go around the pipe was made from $\frac{5}{8}$-in. rod and the plate drilled along its edges to accommodate them. A



Emergency repair to discharge pipe

gasket of rubber sheet was prepared to lay along the crack. Before these parts were assembled, however, a line of soft pine wedges was hammered into the crack along its entire length. Expanding as they became soaked, the wedges practically stopped the flow of water. Then the ends of the wedges were sawed off flush with the pipe and the gasket and plate clamped in place with the U-bolts. For additional protection a block of concrete was cast around the pipes before the hole was back-filled.

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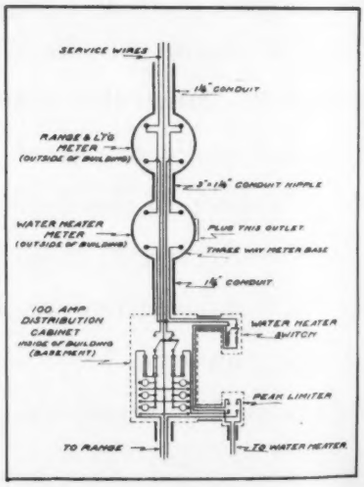
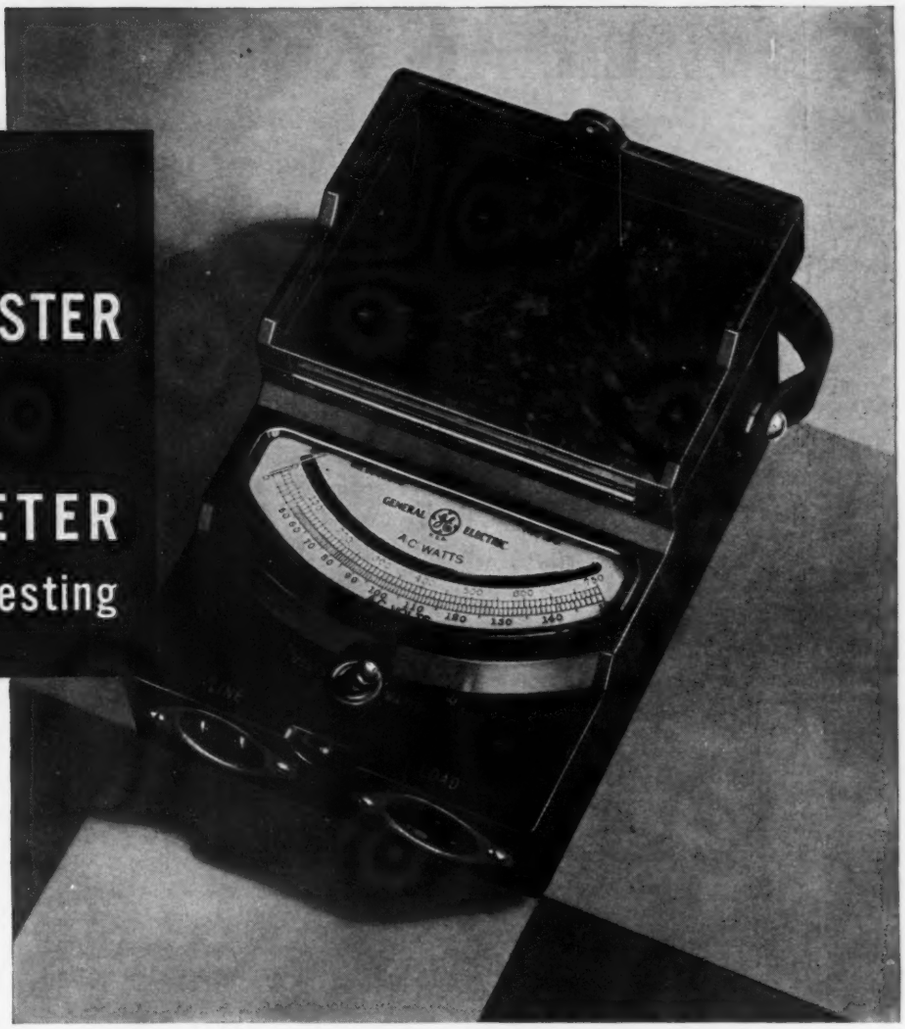
New Sequence Metering Standard



Of the standards developed by the Portland General Electric Company, Portland, Ore., for converting existing services to the new sequence metering the accompanying illustration is of interest. On that system limited flat rate water heating is provided where the consumer uses an electric range, a peak-limiting device mounted inside on the customer's premises cutting off the heater when a certain demand is exceeded, the water heater being metered separately from the other service.

NEW
APPLIANCE TESTER
The
VOLT-WATTMETER
for Simple, Easy Testing



YOU'LL find this camera-size instrument is easy to use. Merely plug the apparatus being tested into one terminal socket, attach the other terminal to the power supply, and read the voltage. Give the switch a snap and read the wattage. Could anything be simpler?

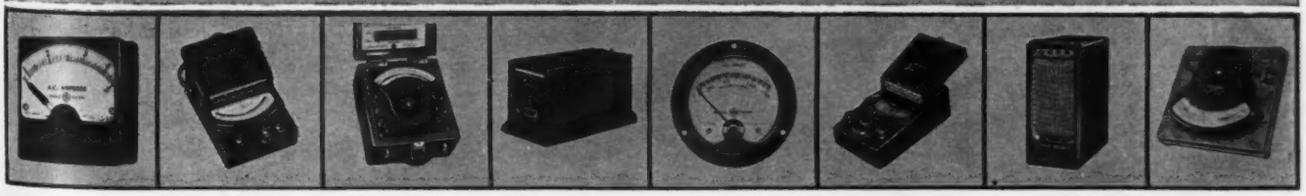
It cuts testing time too. The handy switch and plug-type connectors are twice as quick as conventional types. And that large, 0-150-volt and 0-750-watt scale means a wide application range. The leather handle makes it easy to carry — the hinged cover protects against damage to glass or switch.

Service men will like the volt-wattmeter. They appreciate an instrument that has connection speed, portability, and versatility. And they need it, too, in domestic-appliance testing.

However, this combination represents only one of the large variety of AP-9 instruments. There are voltmeters, ammeters, wattmeters, and milliammeters for all ranges—and all purposes.

Write for a copy of GES-1353 and of GEA-1784. They contain additional information on the volt-wattmeter and other AP-9 instruments. Address your request to the nearest G-E sales office, or to Dept. 6A-201, General Electric, Schenectady, N. Y.

HEADQUARTERS FOR ELECTRICAL MEASUREMENT



Rectangular switchboard | Medium-size portable | High-accuracy portable | Galvanometer | Small panel | Pocket portable | Recording | Laboratory standard

430-65

GENERAL ELECTRIC

POWER AT WORK IN INDUSTRY

New ideas and practices in industrial electrification as presented by industrial, consulting and power sales engineers

Keeps Coal Flowing From Storage Silo

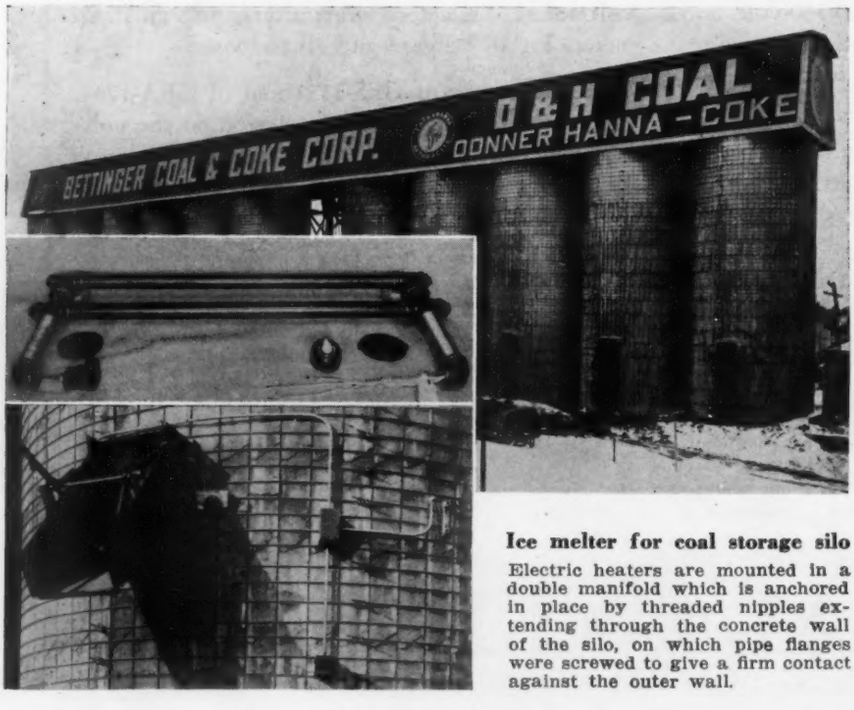
By C. P. YODER
Industrial Heating Engineer, Buffalo, Niagara & Eastern Power Corporation

Flexibility and versatility of electric heat is again illustrated by an interesting application made during the past winter at Buffalo, N. Y.—and, of all places, in a coal storage silo! A large coal and coke company had experienced much annoyance during freezing weather in loading its trucks from the rice and buckwheat coal storage silos. The freezing of condensation in the vicinity of the loading chute and for a distance of about 12 in. back from the radial gates of the chute prevented free movement of the gates as well as flow of the coal through the chute.

Two 1,500-watt electric strip heaters mounted in a double manifold of standard 2-in. pipe which was installed on the floor of the chute directly behind the gate provided the solution of the difficulty.

The temperature of the heater is controlled by a three-heat switch and a thermostat. The function of the latter is mainly to prevent the surface temperature increasing above 300 deg. F., which is considered the danger point above which decomposition of the coal begins. Due to the moisture in the coal, steam and vapor are constantly being produced in the vicinity of the heater, which limits its surface temperature to such an extent that experience will probably demonstrate that the thermostat is unnecessary.

Due to the success of the original installation a second unit is now being installed in another silo.



Ice melter for coal storage silo

Electric heaters are mounted in a double manifold which is anchored in place by threaded nipples extending through the concrete wall of the silo, on which pipe flanges were screwed to give a firm contact against the outer wall.

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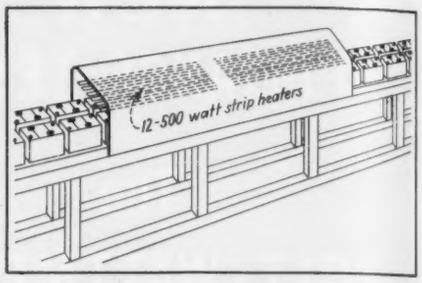
Electric Heat Aids Sealing of Batteries

By DON L. SNOKE
Indianapolis Power & Light Co., Indianapolis, Ind.

In order to insure proper sealing around the cells of electric storage batteries during the process of manufacture it was found advisable not only to apply the asphalt-like sealing compound hot but to have the parts to be closed also at approximately the same temperature as the compound.

A large battery manufacturing plant in Indianapolis does this preliminary heating of the battery top electrically. Just ahead of the station on the production line where sealing is done the work conveyor is covered over with a heat-insulating housing. Inside this "covered bridge" twelve 500-watt strip heaters are installed in the manner indicated in the accompanying sketch. As the batteries pass the housing at normal production line speed the tops are heated sufficiently so that sealing compound is always sure to make effective contact with its joint surfaces.



Heating storage batteries to assure sealing

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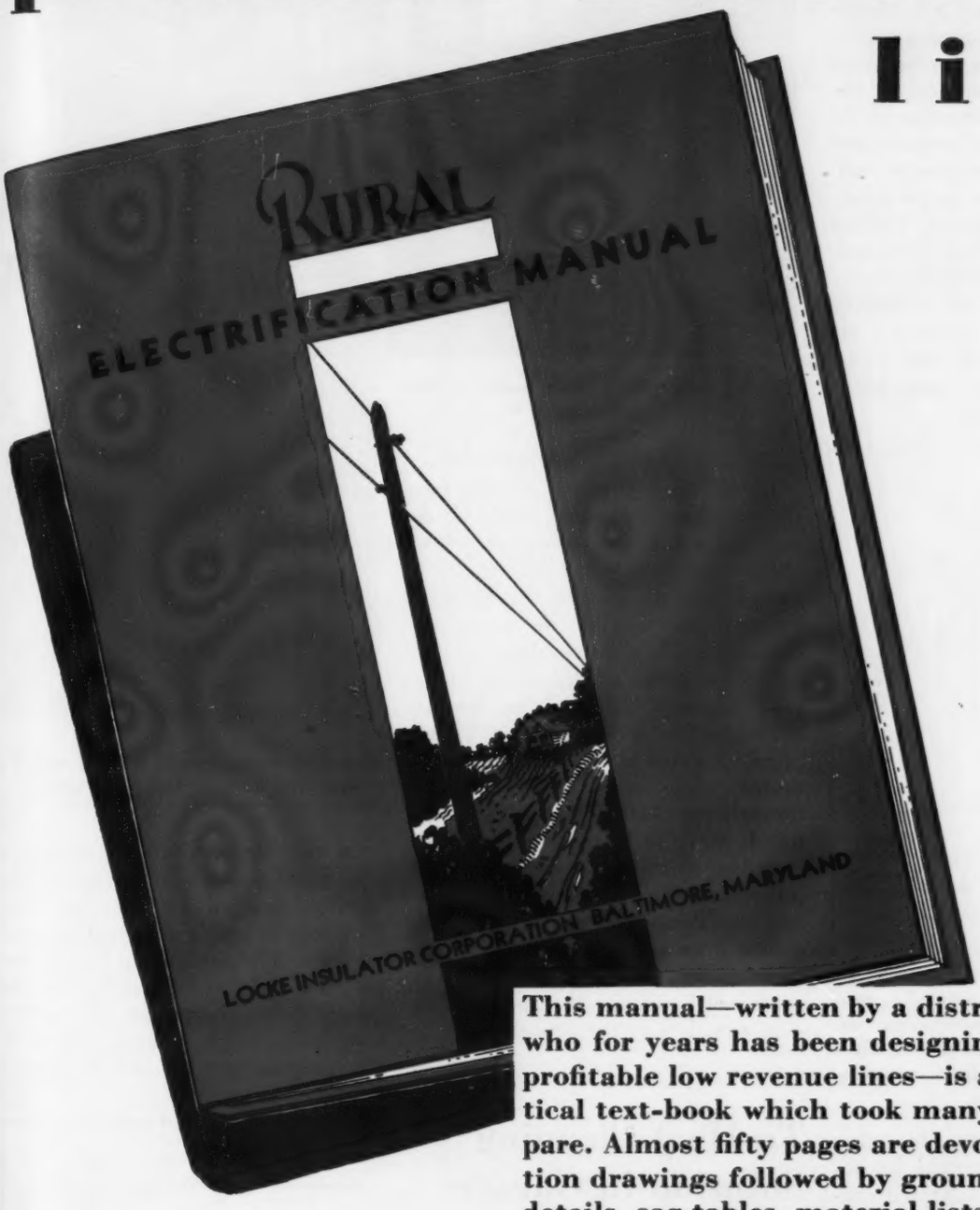
Flicker Reduced by New Reactor Starter

By R. C. ALLEN
Engineering Division, Westinghouse Electric & Manufacturing Co.

Lighting disturbances incident to the starting of large synchronous motors driving compressors for the air-conditioning system of the new auditorium at Kansas City are eliminated by special starting equipment. It is designed to limit current inrush to the motors during starting in small increments or steps of 300 amp. or less and at no more than two-second intervals. This allows proper adjustment of the lighting circuit voltage by the regulators and prevents excessive drop during the starting sequence. Starters used are of the reduced voltage magnetic type arranged for push-button operation.

Both power and light supply is from the low side of the network system giving 199 volts, three-phase for the motors and 115 volts, three-phase, four-wire for the lights. Four motors of the synchronous type were used,

profitable low-revenue lines



This manual—written by a distribution engineer who for years has been designing and operating profitable low revenue lines—is a complete practical text-book which took many months to prepare. Almost fifty pages are devoted to construction drawings followed by grounding and guying details, sag tables, material lists—in fact practically everything you will want to know about the subject.

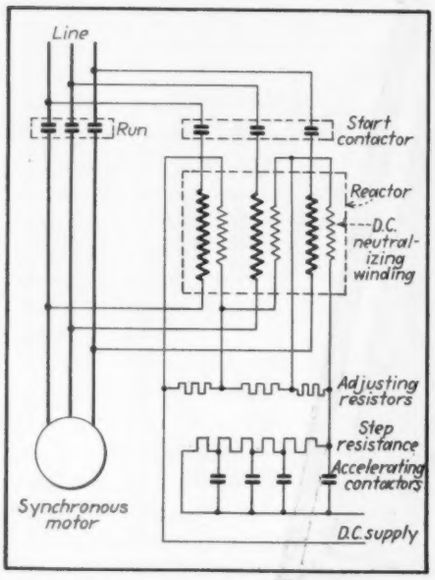
If you are interested be sure to get your copy while the supply lasts. You'll find it a very worthwhile addition to your working library.

LOCKE PORCELAIN INSULATORS

LOCKE INSULATOR CORPORATION BALTIMORE, MARYLAND

each rated at 400 hp., 225 r.p.m., three-phase, 100 per cent power factor.

Reduced voltage for starting is secured from a three-phase a.c. reactor equipped with a d.c. saturating coil so designed that increasing excitation in the coil, during acceleration of the motor, increases the saturation of the reactor, lowering its impedance and permitting a gradual increase in voltage to be applied to the motor terminals until full line voltage is reached and the reactor is short circuited. Direct current is obtained from the exciter motor-generator set. Definite time adjustable relays control d.c. excitation and, therefore, the rate of current change to the motor and, consequently, the transformer.



Special starting reactor with d.c. neutralizing winding for controlling impedance of reactor current changes during acceleration of large synchronous motors

Results obtained with this type starter are better than could be obtained with a resistance type and considerably less space is required.

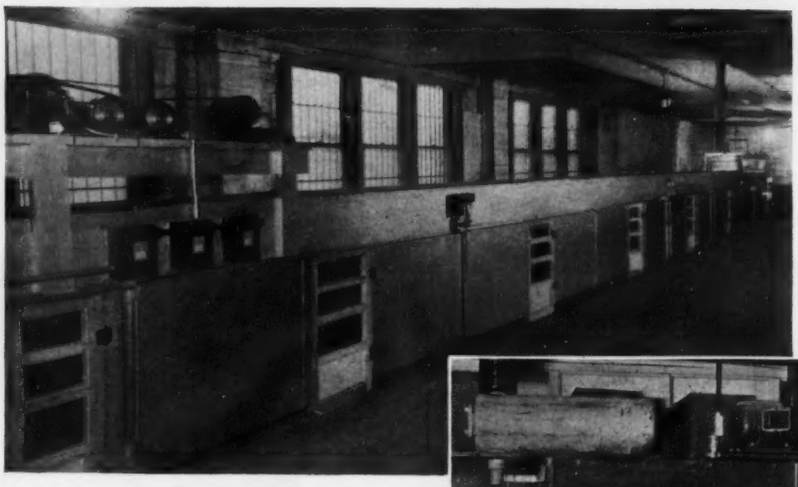
A straight resistance type increment starter for these 400-hp. motors with current increments of 300 amp. per step would have required a seven-step starter. This would mean six starting and one line contactor of large ampere capacity and a large amount of resistance requiring considerable space.

•

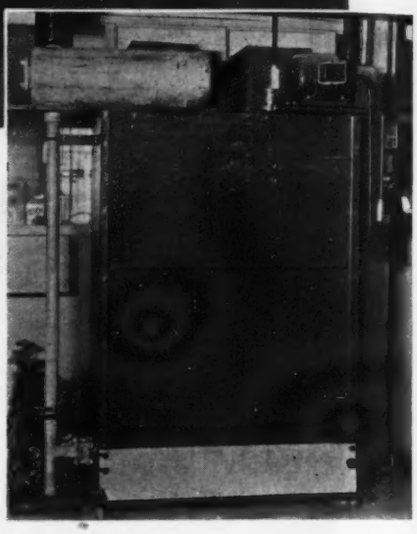
Electrodes Coated in Conditioned Air

As the sale of electrodes used in arc welding of stainless, heat-resisting alloy steels has increased, their volume manufacture has become imperative.

In the final stages of manufacture the electrodes are coated with a chemical flux which also serves as a protective covering. It is important, at this point in the process, that the temperature and humidity be accurately controlled. To maintain these unvarying atmospheric conditions, a Cleveland company, Maurath, Inc., has installed a complete air-conditioning plant. Carried into a separate closed drying room on a belt conveyor, through an electric oven approximately 60 ft. in length, equipped with complete thermostatic control of the different heating unit zones, the moisture requirements of the oven are satisfied with an automatic spray type humidifier which delivers completely conditioned air into the room rather than directly into the oven.



Electric oven 60 ft. long used to dry electrodes



Air-conditioning unit which supplies humidity control the year around

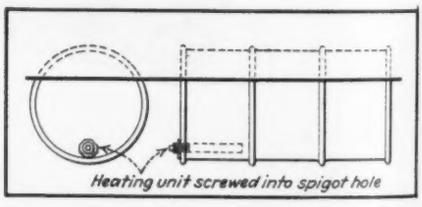
•

To Heat Cleaning Solution in Garages

By H. R. STEVENSON
Detroit Edison Company
Detroit, Mich.

For washing motor and other automobile parts in garages a hot cleaning solution is really necessary. At least one manufacturer positively requires his dealers to use a hot solution in servicing the cars bearing his name. Even though the solution be mostly of carbon tetrachloride or other non-inflammable liquid, the use of combustion heat for this purpose has pronounced bearing on the fire insurance rate. And, except possibly in large garages, steam heat is not economical for this purpose.

In the Detroit Edison territory a considerable usage of electricity for heating cleaning solution has been built up in small and medium-sized garages. The application is very simple, the only money outlay by the garage owner being for the heating unit itself and for the wiring to it. The solution tank is made by cutting a slice off the side of an old oil drum. The cut is made so that the spigot hole in the end comes at the bottom when the drum is laid horizontal, as appears in the accompanying sketch. An immersion type heating unit, usually about 3 kw. in size, is screwed into the spigot hole and the heating tank is complete.



For heating cleaning solution in garages

Oil drum converted to horizontal open tank with bayonet heater in the bung.

ELECTRIFIED LAUNDRIES (Continued) (9)

Air Conditioning

High-quality work and economical operation are directly related to adequate lighting and good atmospheric conditions in the laundry. Heat and high humidity are detrimental to efficiency because they enervate the operatives. Fatigue leads to sickness and accidents.

Operating conditions can be greatly improved by use of fans, cold air supply, ventilating canopies over ironers, vacuum exhausters, etc. Rubber mats can be furnished for employees who have to stand. Special salt tablets are available to assuage fatigue in overheated atmospheres.

Laundries constitute an exacting field of business and should correspondingly be models of sanitary, ventilating and illuminating engineering. Attention to these matters increases public confidence and sustained patronage.

Canopies and Hoods—Used over equipment to prevent escape of steam or heated air into laundry atmosphere. About 30 per cent of weight of goods to be ironed or pressed is moisture, which has to be evaporated in the processing. Both manual and automatic (motor or hydraulic lift) means of raising and lowering canopies, canvas curtain or hoods are available. Vapor drawn off by exhaust system or motor-driven fans.

Ratings—Fan motors ¾-1 hp.; insulated to withstand heat and dampness.

Mfrs.—3, 16, 37, 41, 43. (See Sheet 14.)

Ventilating and Cooling—Fans large enough to give a complete change of air at least twelve times per hour should be used. Air should be filtered or washed to remove dirt, humidified or dehumidified (as required for comfort), cooled or heated (depending upon outside temperatures) and circulated (without objectionable draft). Fans should be installed close to the garage floor to remove carbon monoxide gas. (For Mfrs. see Data Sheets 3 and 7 in Bakery Series.)

Economics of Laundry Operation*

Reductions in operating costs are possible in a great many different ways in operating a laundry. The cost reduction service available through the Laundry Owners National Association and certain others has been outstanding in the conduct of research along these lines. Important points to consider are:

1. Time and motion studies.
2. The economic balance between labor and equipment under varying volumes of production.
3. Study and analysis of processes and flow of production for the most efficient results.
4. Planned schedules for equipment and operations to reduce power demands and improve the load factor for both the equipment and labor.
5. Training employees for maximum efficiency for one or more jobs.
6. The importance of modernization in reducing costs.
7. Careful check-up on supplies.

Hot Water Supply—The size of the boiler and whether or not generating equipment is to be installed and operated in the plant, or power is to be purchased, should be determined by careful consideration of all factors. In many cases the laundry can save money by buying its power. In others, it may be able to save money by installing an engine.

An adequate hot water reserve is a valuable means of reducing peak demands of the boiler. The heat from the steam generated in excess of the immediate requirements of the laundry can be stored in the water of the reserve tank, thus maintaining a satisfactory heat balance.

*Adapted from "Laundries" by American Water Works & Electric Co.

ELECTRIFIED LAUNDRIES (Concluded) (10)

Economics of Laundry Operation (Continued)

Fluctuations in load seriously affect the efficiency of boilers and produce variations in steam pressure, which may be reflected in unsatisfactory operation of flatwork ironers and presses during peak periods when the demand for steam is greater than the normal boiler capacity.

Economizers, heat reclaimers, feedwater heaters, condensate return systems, steam traps and equipment for maintaining an adequate reserve of hot water should be used where indicated on the score of economy. An adequate hot water reserve is a valuable means of reducing peak demands on the boiler. The heat from the steam generated in excess of the immediate requirements of the laundry can be stored in the water of the reserve tank, thus maintaining a satisfactory heat balance.

Steam and water piping should also be selected with care as the satisfactory operation of a plant depends to a considerable extent on the design and character of material of the piping system. Pipes should be of adequate size and properly insulated, all joints should be carefully fitted and free from leaks, and corrosion-resisting materials should be used. Inadequately insulated pipes may cause the loss of a large amount of heat. For instance, 9 sq.ft. of surface of a bare pipe containing steam at 100 lb. pressure per square inch will waste, at atmospheric temperature, 1 lb. of coal per hour. Proper insulation will save 80 per cent of this loss.

Electric-Steam Generation—Electric-steam generators for use in conjunction with presses and flatwork ironers have not been given the consideration they merit, although their convenience and economic advantages have been demonstrated in many industries. The efficiency of this type of steam generator is about 95 per cent as compared with an efficiency of about 50 per cent for coal-fired boilers. Some of the outstanding advantages are cleanliness, full automatic operation, accurate temperature and pressure control and quick steam-generating capabilities.

Purchased vs. Steam Power—Economies and advantages of purchased power reflect in reduced total operating costs and possible increased revenue to the establishment:

1. Elimination of engine or engine-generator load from boiler plant enables closer control of wash water temperature otherwise dependent on engine exhaust. Effects a saving in soap and water; also results in less shrinkage and better appearance.
2. Engine and engine-generators impose a fluctuating load on the boiler with consequent variation in steam pressure and temperature. If the steam temperature falls below the required level, machines such as ironers and pressers cannot be operated at their rated speed, resulting in loss of production.
3. Without the use of expensive control equipment the frequency of the generated current cannot be maintained at a constant value. Reduced frequency lowers speed of the motors so that the maximum output of the equipment cannot be obtained.
4. Elimination of engine supervision allows time for other work.
5. Continuity of service is assured. Breakdown entails costly production losses.

Other Factors—Other major points involved in considering the purchase of engines or the purchase of power are:

1. Availability of money.
2. Time required for return of investment.
3. Interest on investment.
4. Depreciation.
5. Insurance on equipment.
6. Workmen's compensation and liability.
7. Taxes.
8. Space for equipment.
9. Cost of operating labor.
10. Maintenance.
11. Ability of operating personnel.
12. Reliability of service.
13. Breakdowns or interruptions.
14. Weekly and daily load curves.
15. Trend of fuel and supply costs.
16. Trend of purchased power costs.
17. Size of the plant.

NEW ENGINEERING IDEAS

Discoveries, proposals and developments by electrical engineers and scientists in the field, the factory and the laboratory

Portable Register Checker Devised

By E. F. SEARS
Meter Department,
Puget Sound Power & Light Company

The accuracy of a watt-hour meter is dependent on two tests, one to determine the accuracy of the disk speed and the other to determine the accuracy of the register ratio. If the overall per cent accuracy of the meter is too low the power company loses revenue; if too high, the power company loses the good-will of the customer. Therefore, it is of equal importance for the register ratio to be correct as it is for the disk speed to be correct.

To check the register ratio of Westinghouse meters by turning the first counter gear until the register reading changes by one kilowatt-hour requires from approximately two to ten minutes, depending on the ratio of the register. In the course of a day a meter tester will consume an hour or more in checking register ratios if this method is used. In an attempt to decrease the time for checking the ratios of Westinghouse registers, a simple, compact counter, weighing only 11 oz., was devised which reduces the ratio checking time to only about ten or fifteen seconds.

The counter is nothing more than an O.A. register with the worm replaced by a gear in order that the first counter gear may be turned by turning the "units" hand on the register. This counter register is bolted to a frame which contains studs and a guide for mounting the C.B. and O.A. registers and holes for mounting O.B. and O.C. registers. For convenience a knob was attached to the "units" hand on the counter, and the gear ratio was made such that twelve revolutions of the knob would change the reading of a register for a 5-amp., 100-volt meter by 1 kw.-hr., six revolutions for a 10-amp., 100-volt meter, etc.

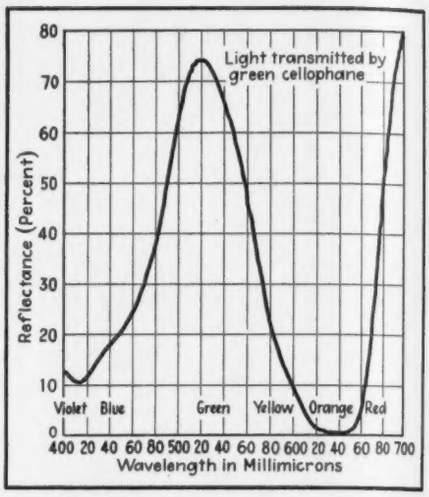
When it is desired to check the ratio of a Westinghouse register it is only necessary to plug the register to be checked into the counter so that the first counter gear of the register meshes with the first counter gear of the counter. The knob of the counter is then turned the required number of revolutions, which in turn causes the reading of the register to be changed by one kilowatt-hour, if the rato is correct.

This device is valuable for both shop and routine testing, can be constructed at a low cost and should be a tool of every meter tester.

•

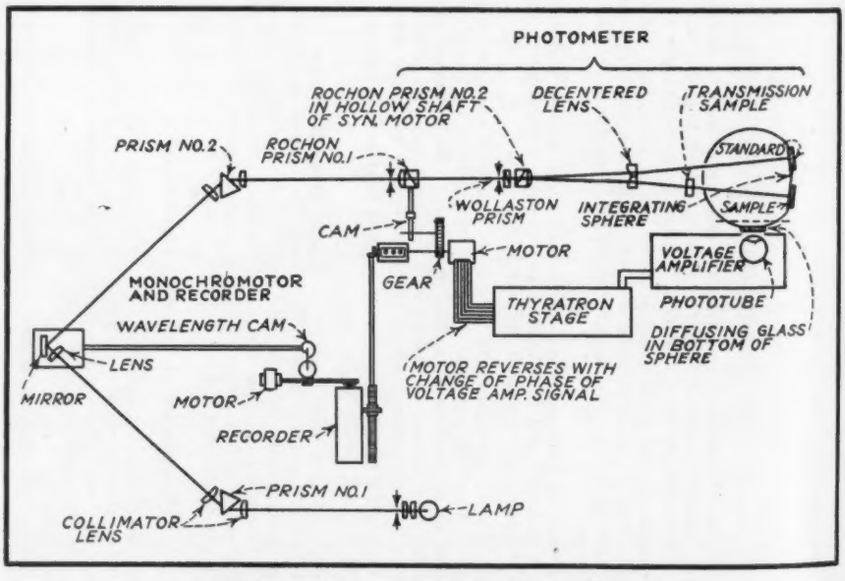
Color Analyzer Plots Reflectance

A record that shows exactly how much of each wave length of light is reflected or transmitted by a given color sample can be automatically produced by a recording photoelectric spectrophotometer displayed by the General Electric Company for the first time at the American Association for the Advancement of Science. Among the fields of usefulness for the new instrument is the cataloguing of the curves of different dyes, inks and pigments so that new colors with predetermined characteristics can be obtained at any time by proper mixture of the standard colors which are already on hand.



Characteristic curve of green cellophane obtained on color analyzer

The instrument consists essentially of a monochromator, photo-electric photometer and a means of recording their indications on a rotating drum. In operation, light from an incandescent lamp is passed through a hollow U tube, through a series of slits, prisms and mirrors. At the outer end of the tube is a hollow sphere. Light reach-



Schematic diagram of recording analyzer

Rotation of No. 2 prism varies light intensity incident on the standard and sample out of phase with each other. A frosted glass in the wall of the integrating sphere is viewed by phototube. When the light reflected from the sample and standard is not equal an alternating component is present in the phototube circuit. Phase of this component with respect to the voltage applied to the synchronous motor determines which of the two reflected beams is more intense. This alternating component then controls direction of rotation of the balance motor, which readjusts prism No. 1 to obtain redistribution of energy in beams and to iron out the alternating component in the phototube current. Angular position of prism No. 1 is then a measure of the reflectance of the sample in terms of the standard.

The Manufacturer's Bulletin Page

KEARNEY
Hi-Line Equipment News

First Edition

VOL. I · No. 1 | St. Louis, Mo., June 20, 1936 | World Copy

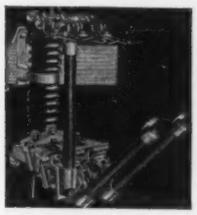
SWITCH EQUIPMENT CO-ORDINATED ON MODERN SUB-STATION POLE JOB

Installation of Kearney Trip-Savers, Trip Outs and Disconnects on Pole Give Protection at Reasonable Cost

Excellent Performance Given by Equipment That Works Together

OF INTEREST to operating men throughout the country are installations such as shown illustrated in the right hand column of this page.

You will notice that in this case two Kearney Trip-Savers, four Trip Outs and three Disconnects were used to obtain a neat, workmanlike sub-station pole job.



By using these three types of Kearney Switches, definite co-ordination of equipment has been accomplished and practical protection has been obtained at an economical cost.

The Kearney Trip-Savers which are here shown are of the reclosing type, with three cartridges. Although this switch has no set cycle of operation, it does have an inherent time delay which is sufficient to permit temporary fault clearance without noticeable service interruption.

On the right hand side of the pole you see four Kearney Trip Outs which give dependable action and positive protection when equipment is endangered by a definite destructive fault load.

The other three switches shown are Kearney Disconnects, a popular switch, widely known in the field and particularly adaptable in the use to which they have been put.

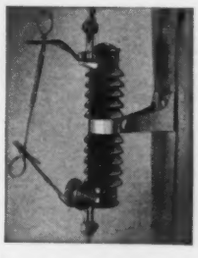
Of interest to field men who are not quite satisfied with the switching equipment which they now are using is the Kearney invitation—"see for yourself how Kearney Switches out-perform all others."

TRIP-O-LINK FUSE SWITCH GAINS CONSIDERATION BECAUSE OF PERFORMANCE AND SAFETY FEATURES

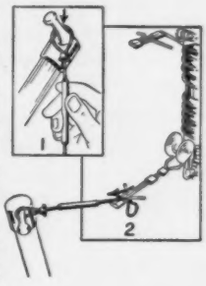
Principles of Its Design Especially Adaptable for Inexpensive Constructions

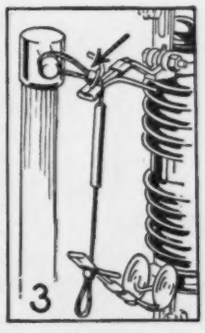
The Kearney Trip-O-Link, here shown, is the one switch, above all others, that Kearney Engineers prefer to recommend for use on rural lines where capacities and budgets are limited.

Important among its features is its safety in fusing, made possible because contacts are in a fixed position which establishes the direction in which the fuse will blow.



Another feature is the safe and easy installation of the fuse as shown in the accompanying drawings: First, puller arm of fuse stick is inserted through top loop of fuse (figure 1). Next, bottom of fuse link body (not loop) is placed into either side of V-Groove (figure 2). And then, with lower part of fuse link installed, top part of fuse link is inserted into top V-Groove contact— body drawn well into contact by pulling forward (figure 3).





The Trip-O-Link is fused and ready for action, as simple as that. If you desire prices and further detailed information, just address:

JAMES R. KEARNEY CORP.
4224 Clayton Ave. St. Louis, Mo.

AN "ALL-KEARNEY" JOB

A well protected sub-station arrangement made possible by the use of modern Kearney Switching Equipment

ing this sphere has been split into two polarized light beams each of the same wave length. During the analysis, as the record drum rotates, the wave length is varied at a uniform rate from the red to the violet end of the spectrum. One of these beams strikes a standard—usually "pure white" magnesium carbonate—and the other the sample under investigation. Comparison of the light reflected by the standard and sample with the aid of the photoelectric photometer yields a plot showing the amount of light of each wave length that is reflected by the sample.

•

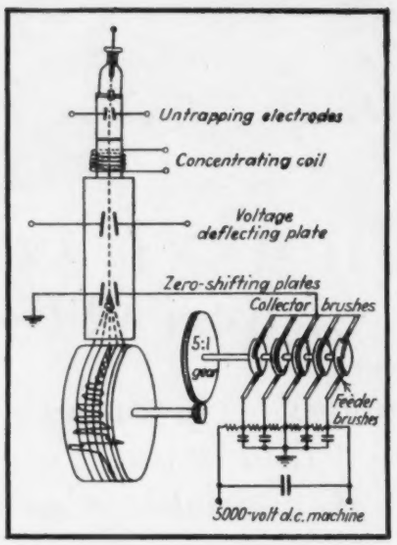
Oscillograph Has High Film Speed

Oscillographic records 32.8 ft. long covering a time period of 0.1 second are obtained on a photographic film moving in a vacuum at a speed of 328 ft. per second in a new all-metal, cold-cathode oscillograph recently developed in England. A high film speed and a relatively long record was necessary in order that frequencies of the order of 50,000 cycles per second and above might be clearly delineated and still make it possible to record five complete cycles of a 50-cycle system.

This instrument, described in a paper by G. A. Whipple before the I.E.E. in London, was designed for use in supplementing a Duddell-type oscillograph for investigation of transformer, reactor, fuse and circuit breaker operation under short-circuit conditions.

A drum which is 6.56 ft. in circumference and rotates in a vacuum at 3,000 r.p.m. is used to hold the oscillograph film. Recording takes place in five revolutions of the drum. Since it is impractical to traverse the drum itself with the object of separating the five traces it was decided to move the beam across the drum by shifting the zero position.

For this purpose a zero-shifting device was employed as illustrated in the accompanying diagram. This device employs a five-step, 5,000-volt, d.c. potential divider in conjunction with a five-disk commutator system. Brushes of this commutator system apply varying potentials across deflecting plates of the oscillograph during each of five revolutions of the camera drum. The zero position of the oscillograph beam is therefore shifted laterally at the commencement of each successive revolution, thus giving separate traces.



Drum camera gives 32-ft. oscillograph record on 6.56-ft. film by using zero-shifting device

Film moves 328 ft. per second in vacuum of 5x10 mm. of mercury.

The complete oscillograph was designed to record phenomena on each phase of a three-phase test circuit. It is operated generally at accelerating voltages between 30 and 50 kv. and between 0.5 and 1.2 milliamperes, anode cathode current. An anode diaphragm of 0.2 mm. diameter is generally used.

•

Disk Calculator for Vector Components

By GORDON R. SHUCK

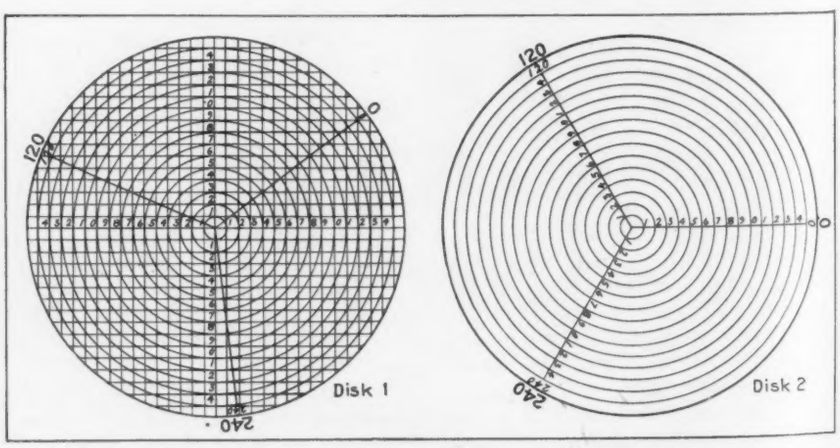
Associate Professor of Electrical Engineering, University of Washington

The slide rule herein described was developed to eliminate laborious calculations when rotating vectors in symmetrical calculations. Vectors frequently must be rotated 120 deg. and 240 deg. Ordinarily this is accomplished by multiplying the vector by $(-.5 + j.866)$ for 120 deg. rotation anti-clockwise, or by $(-.5 - j.866)$ for 240 deg. rotation in the anti-clockwise direction.

This slide rule performs the operation mechanically. For example, if any one of a set of three balanced component vectors is known the two others may be read directly from the slide rule with only one setting. The slide rule consists of two circular disks. The lower disk 1 is marked off in rectangular co-ordinate scales with the zero position in the center. The upper disk 2 is transparent and is marked with three polar lines, 120 deg. apart, each line marked to the same scale as the co-ordinates on disk 1. One of the polar lines is called the zero line. Both disks rotate about the same axis.

To illustrate operation, the voltage $E = 40 + j30$ is assumed as given. The problem is to obtain values of the vector after it has been rotated 120 deg. and 240 deg.

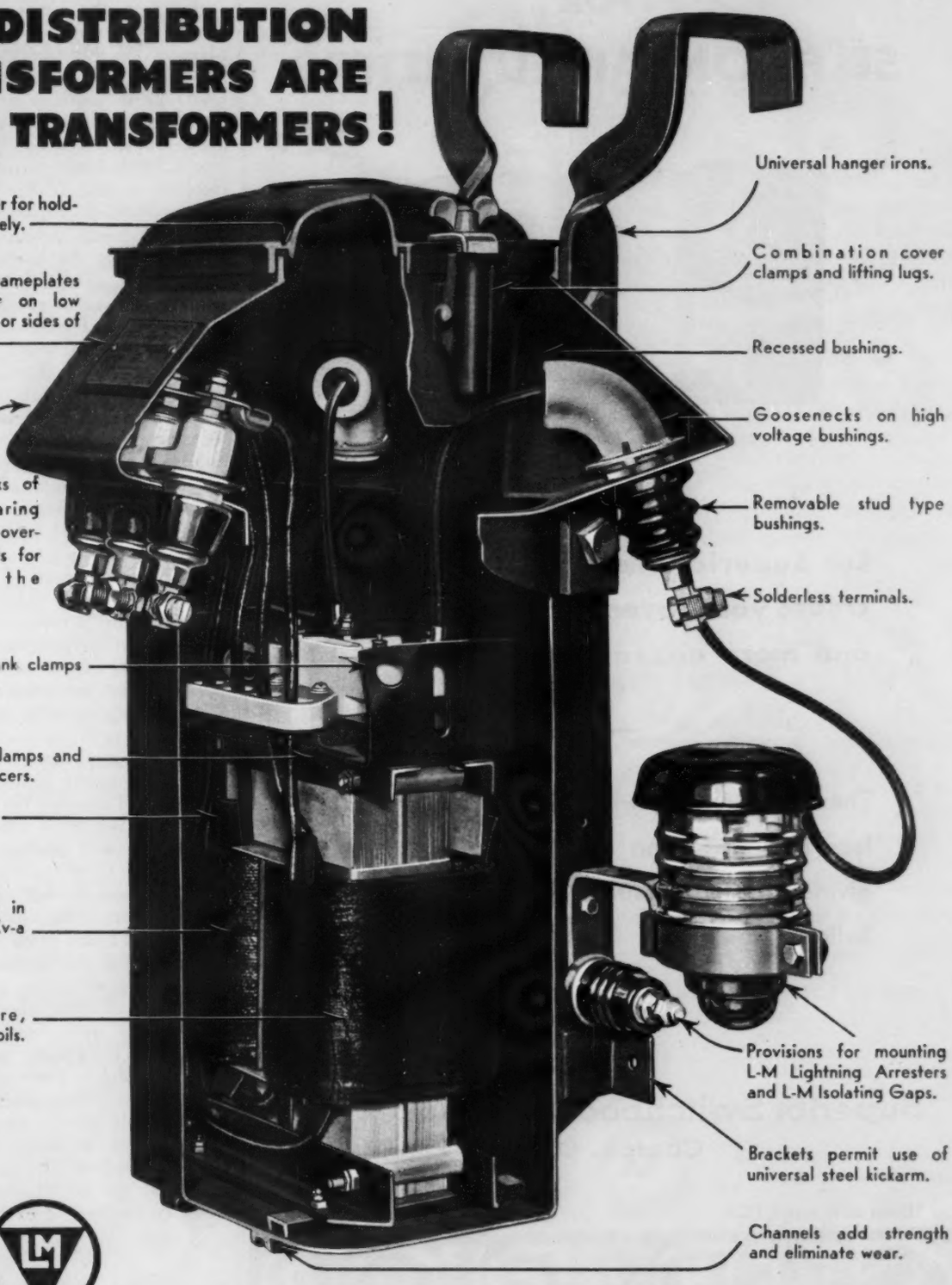
The zero line of disk 2 is set on co-ordinates 4 and j3 of disk 1. On the zero line of disk 2 a reading is taken in this case 5. At the same scale reading on the other polar lines of disk 2 the rotated co-ordinate values are read on disk 1. In this case they are $-4.6 + j1.95$ on the 120-deg. line and $.6 - j4.95$ on the 240-deg. line. Other rotations may be effected by drawing appropriate polar lines on disk 2; in fact a complete polar scale may be drawn on disk 2 and a logarithmic scale on the index line of disk 2, thus converting the instrument into a general complex quantity slide rule.



Simple, easily constructed circular slide rule assists calculation of symmetrical components

look into it !

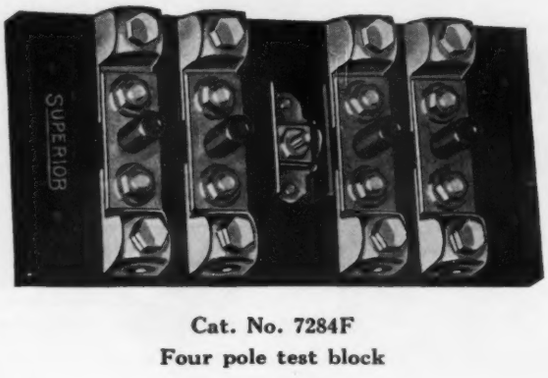
L-M DISTRIBUTION TRANSFORMERS ARE GOOD TRANSFORMERS!


Universal hanger irons.
Seat in cast cover for holding gasket securely.
Combination cover clamps and lifting lugs.
Stainless steel nameplates mounted either on low voltage pockets or sides of tanks.
Recessed bushings.
Goosenecks on high voltage bushings.
All-welded tanks of copper-bearing sheet steel with overhanging pockets for protection to the bushings.
Removable stud type bushings.
Solderless terminals.
Combination tank clamps and lifting eyes.
Rugged core clamps and core clamp spacers.
Extra insulation.
Lo-Hi-Lo coils in the smaller Kv-a ratings.
Rectangular core, form wound coils.
Provisions for mounting L-M Lightning Arresters and L-M Isolating Gaps.
Brackets permit use of universal steel kickarm.
Channels add strength and eliminate wear.

LINE MATERIAL CO.

SOUTH MILWAUKEE, WISCONSIN, U. S. A.

METER TEST BLOCKS
FOR
SELF-CONTAINED METERS



Cat. No. 7284F
Four pole test block

Let Superior Meter Test Blocks increase your revenue by safer, faster and more accurate meter tests.

These Test Blocks, with their forged solderless lugs, lowering installation costs and giving positive contact, are described in Bulletin 364. Ask for it.

Superior Switchboard & Devices Co.
Canton, Ohio

*Been at it Since 1920

SUPERIOR
REG. U. S. PAT. OFF.

Industrial Show on Wheels

European countries have found it necessary to make every effort to stimulate home industry with a view to recovering from the depression.

In Switzerland, which is about as large as the three southern New England states and is comparable with Massachusetts as to population, a traveling exhibit is this summer reaching 72 cities and towns. It is carried on a ten-car train, 700 ft. long. A space of 30 ft. is alloted to a joint display by a number of manufacturers, sponsored by the Association "Electrical Industries," relating to electricity in the home. One feature of this is an all-electric kitchen, of which the effectiveness is enhanced by suitable lighting and informational posters.

Switzerland is world famous for its scenery but the thorough-going Swiss don't even leave that to chance. The housewife in her kitchen is supposed to have a window over the electric range and to be able to enjoy the view while she works. The railroad siding may not afford this attraction, so a large artificial window is provided, backed by a brightly lighted landscape, to give the desired effect of spaciousness.

At each stopping place, this display is available for demonstration by representatives of the local utility, and as evidence of its effectiveness the statement is made that two persons are scarcely able to keep up with the answering of questions.

The itinerary weaves back and forth across the country with one-day stops at villages and two-day or three-day stops at a very few large cities, so that the entire trip will consume nearly three months.

The purpose is to bring the "traveling fair" to every inhabitant of the country and thus to reach those who are unable to visit any of the regional exhibits.

Assurance of success is found in the experience of 1934, when a similar but shorter trip drew more than 200,000 visitors. The project is described in *Wasser- und Energiewirtschaft.*

The country is pre-eminent in the fact that virtually 100 per cent of the homes are reported to have electric service and the problem is, therefore, one of increasing the use of electrical conveniences on the part of existing customers.

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An Informal Report

Announcement has been made that Westinghouse Electric & Manufacturing Company is issuing a "stockholders quarterly" containing news and comment of the quarter. The first issue was mailed on May 30.

BUILDING UP THE LOAD

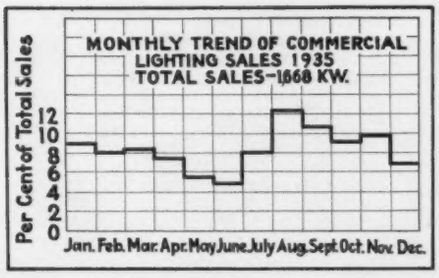
New ideas and practices in selling electrical equipment and service to industrial, commercial and domestic customers

Selling Lighting All the Year Round

By LADNER V. ROSS
Illumination Engineer
Washington Water Power Company,
Spokane, Wash.

For years it has seemed as if utility companies have conceded that lighting cannot be sold during the summer months. Most lighting campaigns begin in the fall and continue through the "dark" months. Experience in 1935 on the Washington Water Power system indicates that perhaps this conception of the way to build lighting business can be improved.

In analyzing the sales made for the year by lighting salesmen, it was found that the volume held up well during early summer and gradually increased to a peak month in August. Monthly sales results are indicated on the accompanying graph. The sustained volume of sales shown by the graph is attributed to a well-planned year-around lighting sales program which requires continuous effort on the part of the salesman. Especially significant is the fact that, upon checking to find why August should be peak month for the year, we found that propositions upon which salesmen had been working since early spring materialized. Included in these were remodeling or rebuilding projects which required continuous and diligent effort on the part of the salesman over a period of months.



Commercial lighting sales of the Washington Water Power Company obtained by lighting salesmen only show August as peak month of the year

To obtain a modern and satisfactory lighting installation on any prospect's premises often requires consistent and persistent selling efforts over a long time. The graph depicts the results of this type all-year selling. It is true that there is a large volume of pick-up lighting business in relamping, refixturing and in portable equipment that can be obtained only during the short, dark winter days. There are many more kilowatts in larger units awaiting the utility which plans a consistent, well-manned, long-pull lighting sales program which eliminates the time-worn sales excuses so frequently resorted to—"it's the summer slump."

Sales Magazine for Employees

"It is the purpose of the *Sales Messenger* to acquaint every employee with the latest information about appliances and services the company provides. As an important part of the modernization and home-building program now sweeping the country you should know and be able to tell your friends what the company has to offer."

In these words is introduced a new employee publication of the Public Service Company of Northern Illinois which will go to every employee. In the eight pages of the new publication are stories describing items of merchandise and explaining how any employee can earn commissions on their sales.

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Do Home-Lighting Advisers Pay Way?

By LEONA E. BERLIN
Indianapolis Power & Light Company,
Indianapolis, Ind.

In 1935 thirteen home-lighting advisers added more than 634 kw. of domestic lighting load to the system of the Indianapolis Power & Light Company. Considering that this new load mostly comes on the first rate step,

Brooklyn Edison Company Now Serving More Than 10,300 Hp. of Air Conditioning

Air-conditioning data shown in ELECTRICAL WORLD's previous tabulation (February 29, 1936, page 90) is supplemented by the following details of Brooklyn Edison's accomplishments.

Classification	Prior to Dec. 31, 1932 No.	Hp.	1933 No.	Hp.	1934 No.	Hp.	1935 No.	Hp.
Bakery shop	..	.....	1	W1.75	..	.....	1	3.25
Bank	2	617.5	..	.....	1	10.65	1	25.5
Beauty parlor	..	.....	..	.....	..	.....	1	3.2
Department store	1	220.0	..	.....	1	80.0	1	E10.0
							1	1662.0
Dress shop	..	.....	..	.....	3	61.5	5	48.0
Drug store	..	.....	..	.....	..	.....	1	6.4
Electrical store	1	6.55	..	.....	..	.....	..	.....
Funeral parlor	1	9.45	..	.....	..	.....	2	39.75
Furrier	..	.....	..	.....	..	.....	1	1.5
Hospital	..	.....	..	.....	1	0.5	..	.....
Liquor store	..	.....	..	.....	1	6.5	1	3.0
Men's furnishings	..	.....	..	.....	..	.....	2	6.4
Office, doctor's	..	.....	..	.....	2	1.55	6	11.7
Office, general	..	.....	..	.....	1	E10.5	3	106.5
					3	90.2		

Classification	Prior to Dec. 31, 1932 No.	Hp.	1933 No.	Hp.	1934 No.	Hp.	1935 No.	Hp.
Office, private	1	1.05	3	3.4	1	1.0	7	12.57
Residence	1	5.0	1	1.00	1	5.0	8	8.90
Restaurant	..	.....	3	54.1	3	112.0	1	W17.5
							3	48.0
Shoe store	1	10.0	..	.....	2	17.75	5	50.0
Theater	13	5411.0	4	W187.5	8	W247.5	10	W225.5
Total comfort cooling	21	6280.55	11	247.75	28	644.65	60	2289.67
Industrial	5	220.0	2	33.2	8	281.0	5	325.05
Total comfort cooling and industrial	26	6500.55	13	280.95	36	925.65	65	2614.72

W = Cold water for cooling coils obtained from well. E = Evaporative cooling.

its value is considerable in revenue. Also, these thirteen girls were directly responsible for sales of lighting equipment and domestic appliances, including ranges, water heaters and refrigerators, that amounted to approximately $10,000. Any commercial executive who will take the troble to make a rough evaluation of these accomplishments in terms of local conditions will readily see that these lighting advisers have much more than paid their way.

The work in the homes, none of it direct selling, but entirely recommendatory, was facilitated by the activities of a Sight-Saving Council, in which oculists, optometrists and opticians took an interested part, and by talks to department store groups, women's clubs and parent-teacher association meetings. In the ten days of the annal Indianapolis Home Show more than 7,000 people visited the home-lighting exhibit. Also, the home-lighting supervisor of the company made 45 five-minute radio talks and the three local newspapers carried 36 stories on home lighting in addition to paid advertising. The accompanying tabular summary presents the performance figures.

1935 Report Home-Lighting Service Department

Home-lighting advisers employed	13
Number of calls	12,476
Number of demonstrations	6,605
Total wattage recommended	3,189,239
Average wattage recommended per home	482
Number of call-backs	5,253
Number in which wattage changes were made	2,984
Wattage installed on original calls	29,425
Wattage installed without demonstrations	12,770
Wattage installed on call-backs	591,997
Total wattage installed	634,192
Average wattage added per home	213
New Equipment Merchandise Recommended	
Number of shades	28,906
Number of portables	6,293
Number of fixtures	2,353
Number of lamp bulbs	64,263
New Equipment Merchandise Sold Due to Recommendations	
Lamp bulbs	14,054
Shades	2,248
Portables	796
Fixtures	171
Major Appliances Sold Resulting from Home-Lighting Calls	
Ranges	14
Water heaters	2
Refrigerators	1
Sweepers	2
Approximate value of merchandise sold	$10,000.00

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Domestic Diversity Found High

High diversity among domestic customers is recognized, but there is limited data on actual values. Some light is thrown on this, at least for a group of homes that have a high degree of similarity, by B. Handley in a recent London paper on "Tariffs for Domestic and Business Premises" before the Institution of Electrical Engineers. His information was derived from studies by J. N. Waite of an "estate of 500 working-class houses" at Hull, each equipped with cooker, washer and lighting. The accompanying table, derived from Hendley's article, gives some interesting data on diversities in small homes.

Diversities for 500 Modest Homes

Details of Supply		
Number of houses		500
Total installed capacity (kw.)		4,300
Individual maximum demand of each house (kw.)		5
Summation of individual maximum demands (kw.)		2,500
Actual combined simultaneous maximum loads		
(a) At time of undertaking peak (kw.)		100
(b) At time of local distribution peak (kw.) (11:30 a.m., August 9)		320
Total energy sold (excluding street lighting, kw.hr. per annum.)		570,000
Derived Data		
Installed diversity:		
(a) On undertaking peak	4 300/100	= 43.0
(b) On distribution peak	4 300/320	= 13.4
Operating diversity:		
(a) On undertaking peak	2 500/100	= 25.0
(b) On distribution peak	2 500/320	= 7.8

Estimated Revenue From Water Heaters

By R. M. WINSBOROUGH
Southwestern Gas & Electric Company, Shreveport, La.

For computing estimated annual revenue figures for water heaters the Southwestern Gas & Electric Company takes into account only the revenue obtained from the off-peak unit because local average water temperatures make use of the top element unnecessary. The results obtained from checks on 76 water heaters are shown in the accompanying table. The 30-gal. heaters were metered for a total of 6,764 days, during which time they used 39,812 kw.-hr., or an average of 5.9 kw.-hr. per day. At 1 cent per kilowatt-hour this gave an average cost of $1.77 per month, or an estimated annual revenue of $21.24 per year.

In the case of the 50-gal. heaters 32 families were considered. In this group the heaters were metered for a total of 5,640 days, during which time they used 53,552 kw.-hr., or an average of 9.5 kw.-hr. per day. This amounts to $2.85 per month, or $34.20 per year.

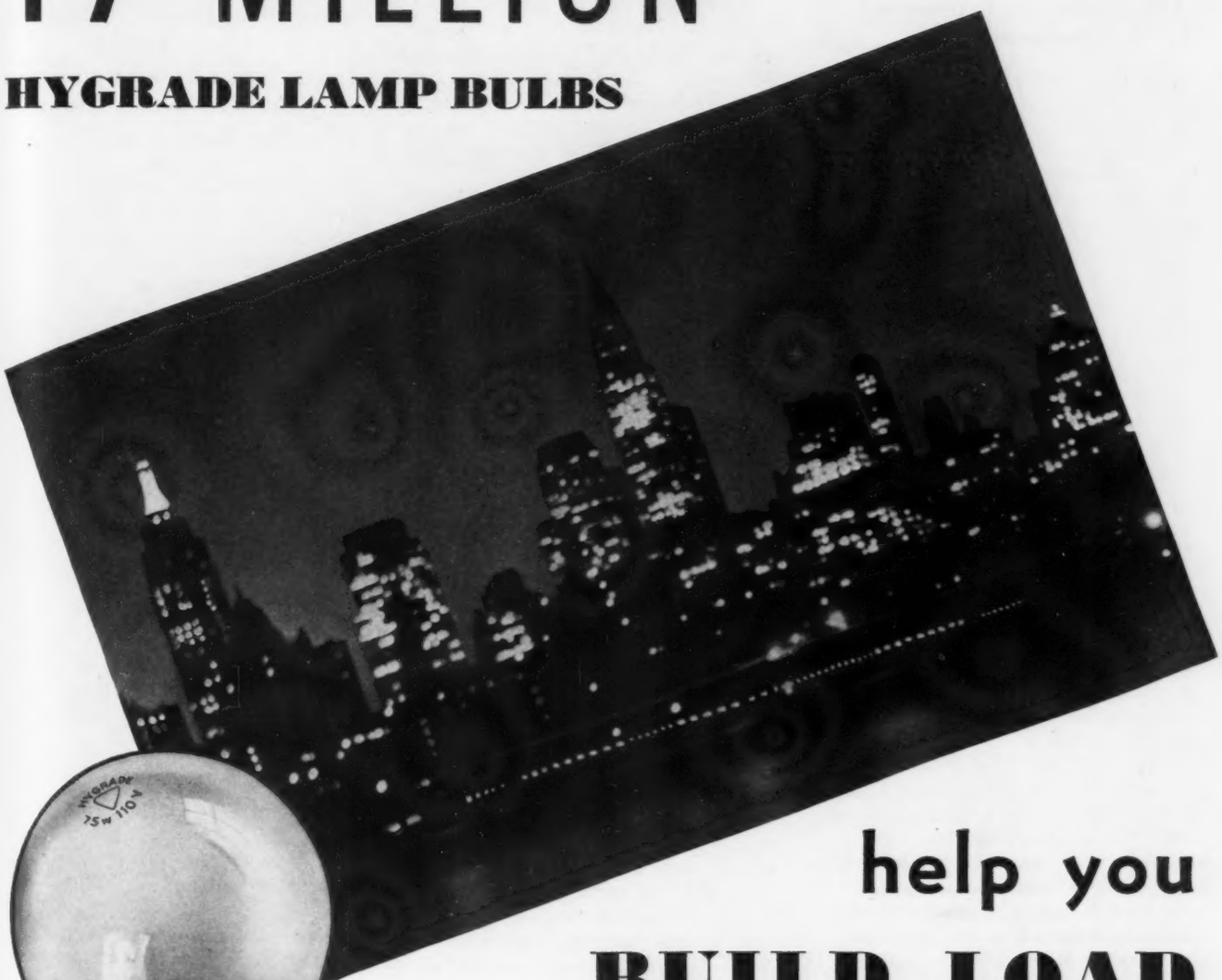
The tabulation indicates that the average cost per person per month for hot water using a 30-gal. tank is $0.467. The average cost per person per month for a family using a 50-gal. heater is $0.457.

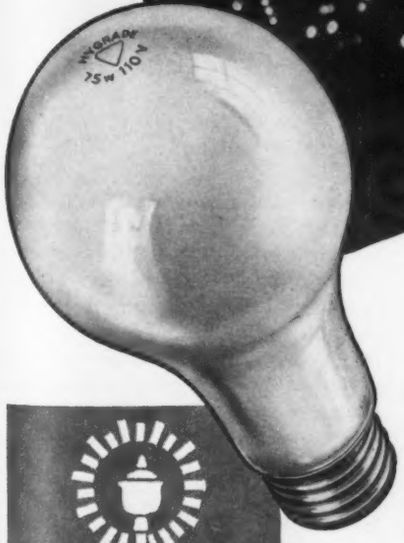
Table of Off-Peak Water Heater Costs

No. in Families	No. of Families	Total No. Days Metered	Total Kw.-Hr. Used	Avg. per Day	Avg. Cost per Mo.	Cost per Person per Mo.	Est'd Annual Rev.
30-Gal. Capacity							
Two	13	2,390	8,662	3.6	$1.08	$0.54	$12.96
Three	8	964	5,718	5.9	1.77	0.59	21.24
Four	13	1,913	13,037	6.8	2.04	0.51	24.48
Five	5	753	5,428	7.2	2.16	0.432	25.92
Six	3	577	4,873	8.4	2.52	0.42	30.24
Seven	..	....	.....	....	....	....	.....
Eight	1	109	1,204	11.4	3.42	0.4275	41.04
Nine	1	62	890	14.3	4.29	0.476	51.48
Average	44	6,764	39,812	5.9	$1.77	$0.467	$21.24
50-Gal. Capacity							
Two	2	385	3,172	8.2	$2.46	$1.23	$29.52
Three	8	1,127	8,228	7.3	2.19	0.73	26.28
Four	8	1,393	13,418	9.6	2.88	0.72	34.56
Five	4	751	9,520	12.7	3.81	0.76	45.72
Six	6	1,198	11,710	9.8	2.94	0.49	35.28
Seven	..	....	.....	....	....	....	.....
Eight	3	729	6,637	9.1	2.73	0.34	32.76
Twelve	1	57	867	15.2	4.56	0.38	54.72
Average	32	5,640	53,552	9.5	$2.85	$0.457	$34.20
Over-all average (4.1)	76	163	1,228	7.56	$2.27	$0.55	$27.24

17 MILLION

HYGRADE LAMP BULBS

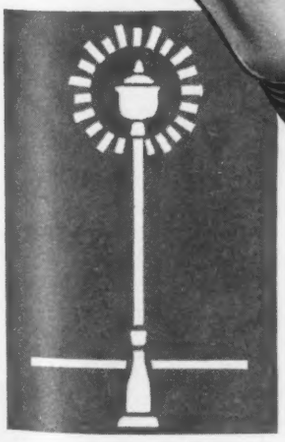




help you BUILD LOAD

Over seventeen million incandescent lamps, eighteen million radio tubes sold during 1935 in this country were Hygrade-Sylvania made. As the third largest manufacturer of incandescent lamps, and second largest of radio tubes, Hygrade-Sylvania products are efficiently consuming an important part of the total current sold by public utilities the country over. Many of these lamps and tubes are helping to build load on *your* lines.

When you are buying lamps (multiple or series) for street lighting, Hygrade-Sylvania Corporation deserves your consideration. Hygrade Lamps offer you the opportunity to make definite economies in street lighting costs without the slightest sacrifice of quality. Let us prove it with facts and figures!



SPECIALISTS IN STREET LAMPS

Hygrade LAMP BULBS

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MEN OF THE INDUSTRY

Allis-Chalmers Promotes L. W. Grothaus

L. W. Grothaus of Allis-Chalmers Manufacturing Company, Milwaukee, Wis., recently elected vice-president, has had 32 years of wide experience with that organization, at first working successively in the Norwood shops, purchas-

ing department, drafting rooms and engineering departments. In 1913 he joined the sales staff of the Milwaukee district office, but in 1917 was loaned to the government as a member of the staff of the War Industries Board. On his return he became district sales manager, first of the company's Minneapolis office and later at Cleveland.

In 1925 he was made assistant manager of the electrical department at the Norwood works, and in 1929 became assistant manager of the electrical department at Milwaukee. In 1931 he was made general representative of the company, and in 1933 assistant to the president, his immediate work being especially with matters pertaining to the National Industrial Recovery Act. For many years Mr. Grothaus has been active in the affairs of the National Electrical Manufacturers Association, as well as the Machinery and Allied Products Institute and other organizations.

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▶ JOHN A. FERGUSON of Cape Girardeau, Mo., has been appointed by Gov. Guy B. Park a member of the Missouri Public Service Commission to fill the vacancy caused by the recent resignation of George English of Kansas City. Mr. Ferguson will serve on the state commission until 1937.

▶ DR. BANCROFT GHERARDI, vice-president and chief engineer of the American Telephone & Telegraph Company, was made the recipient last week of the honorary degree of doctor of engineering by the Worcester Polytechnic Institute. Dr. Gherardi is a past-president of the American Institute of Electrical Engineers. The Edison medal for 1932 was awarded to him by the institute "for his contributions to the art of telephone engineering and the development of electrical communication."

•

Everett Morss, Jr., Heads Simplex Wire & Cable

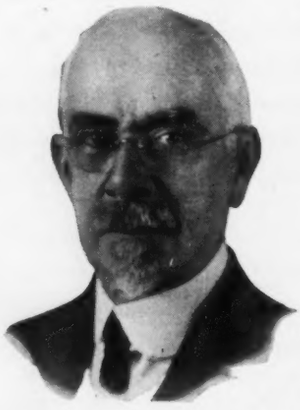
Everett Morss, Jr., formerly vice-president, clerk and secretary of the Simplex Wire & Cable Company, Boston, Mass., has been elected president and treasurer, succeeding the late Henry A. Morss. Charles R. Boggs, formerly vice-president and factory manager, has been made general manager, retaining his title as vice-president, and Vice-President Philip R. Morss has added the duties of clerk and secretary to his other tasks. Assistant Treasurer J. Arthur Gibson also becomes a vice-president. William S. Davis and George L. Roberts continue as sales manager and assistant sales manager, respectively.

•

C. D. Flanigen Retires

C. D. Flanigen, veteran manager of the Athens division of the Georgia Power Company, retired from active service June 1 following fifty years of service with the company. He is 82 years old. In 1879 he became superintendent of the Athens gas plant, and in 1894, he was made superintendent of the Athens Electric Railway Company, which he had helped to build.

Mr. Flanigen designed and supervised the construction of the Mitchell Bridge



hydro-electric plant, completed in 1898; the Tallassee Shoals plant, completed in 1902, and the Barnard Shoals plant, completed in 1910.

Upon consolidation of the Athens company with the Georgia Power Company in 1927, Mr. Flanigen was made general manager and subsequently vice-president of the company. He will retain his position as vice-president.

He is succeeded in Athens by T. A. Gibson, assistant general superintendent of the Athens division.

•

Price New Chief Engineer of Canadian Westinghouse

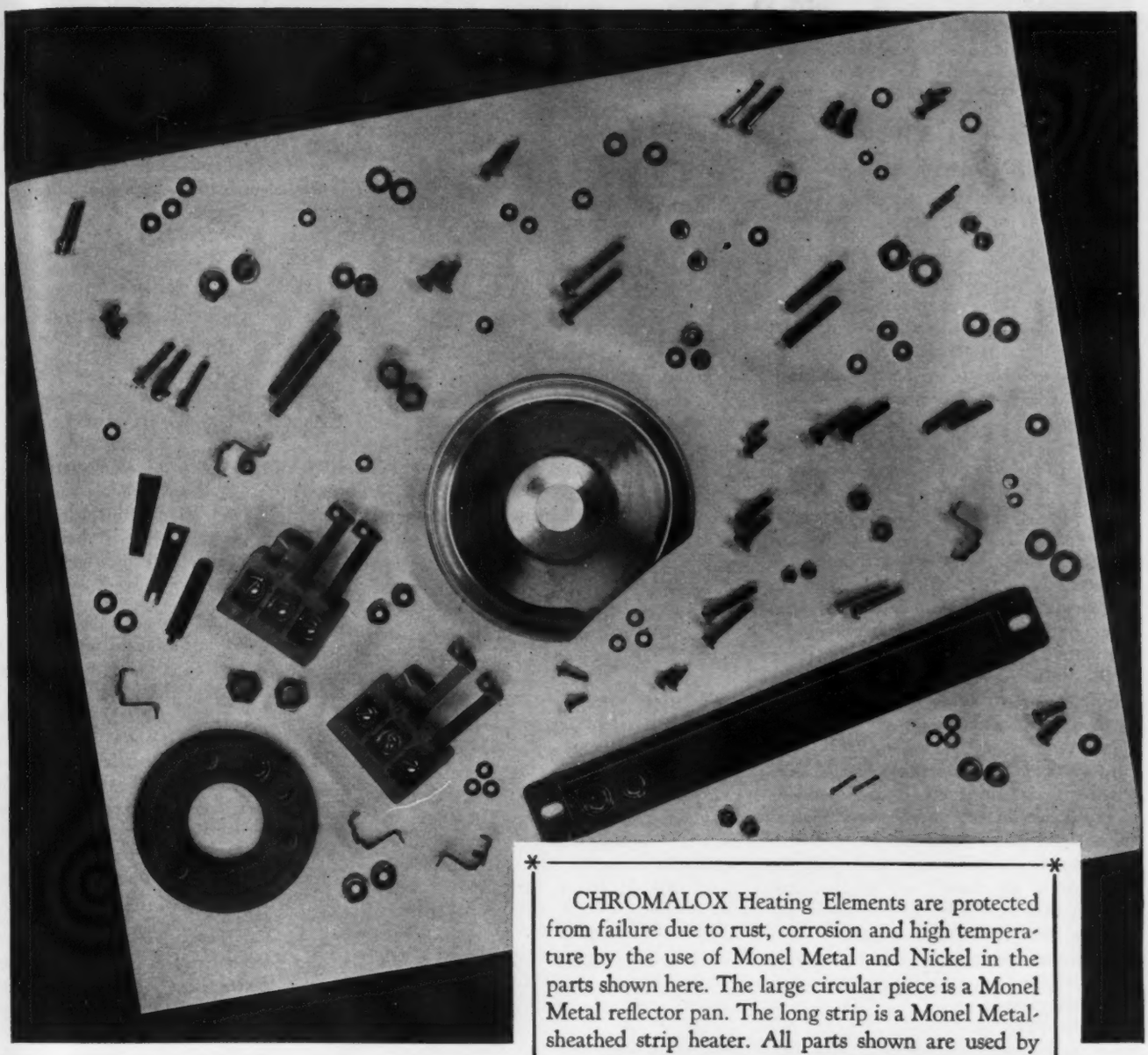
Canadian Westinghouse Company has announced the appointment of C. A. Price as chief engineer and L. B. Chubbuck as assistant chief engineer of the company. Following graduation from Drexel Institute at Philadelphia, Mr. Price became identified with John A. Roebling's Sons Company, Trenton, N. J., and later with the Bell Telephone Company at Philadelphia. He then joined the Westinghouse Electric &

Manufacturing Company at East Pittsburgh, Pa.

In 1906 he was placed in charge of induction motor and transformer design for the Canadian Westinghouse Company. He was appointed assistant chief engineer in 1919. Mr. Price has done notable work in the application of electrical apparatus to industrial use and especially in connection with large mining hoists. He has been intimately connected with all the important Hydro-Electric Power Commission installations for many years. He is a member of the Engineers Club of Toronto and the Toronto section of the American Institute of Electrical Engineers, of which he was chairman 1934-35.

A graduate of Toronto University, Mr. Chubbuck joined Canadian Westinghouse as engineer in charge of switching equipment. Since that time he has been connected with the design of switching and control equipment of most of the larger Canadian electrical installations.

Mr. Chubbuck has given papers before many of the technical organizations of the country, such as the Canadian Electrical Association, the American Institute of Electrical Engineers, of which he was vice-president in 1930 and chair-



CHROMALOX Heating Elements are protected from failure due to rust, corrosion and high temperature by the use of Monel Metal and Nickel in the parts shown here. The large circular piece is a Monel Metal reflector pan. The long strip is a Monel Metal-sheathed strip heater. All parts shown are used by

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MONEL METAL *or* SOLID NICKEL

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Monel Metal is a registered trade-mark applied to an alloy containing approximately two-thirds Nickel and one-third copper. Monel Metal is mined, smelted, refined, rolled and marketed solely by International Nickel.

man of the Toronto section previously, Engineering Institute of Canada and the Ontario Municipal Electrical Utilities. He is also on several committees of the Canadian Electrical Standards Association.

•

L. S. Wells Completes Fifty Years of Service

Loren S. Wells, electrical engineer of the Pennsylvania Railroad System, completed on June 10 half a century of service with the Pennsylvania and Long Island railroads, and in recognition of his long period of continuous employment a testimonial luncheon was given in his honor by a group of associates at the Engineers' Club in New York. In addition to his railroad duties, Mr. Wells had charge of the installation and operation of isolated electrical plants of certain outside interests, giving special attention to the design and erection of electric signs. He entered the employ of the Long Island Railroad in 1886. In 1903 and 1904 preliminary studies were made by Mr. Wells in connection with the extensive electrification of the Long Island Railroad properties, and when the company's electrical committee was organized he became one of its active members.

In 1905 Mr. Wells was appointed electrical superintendent and superintendent of telegraph, in charge of power plants, substations, power transmission and distribution lines and responsible for the efficiency of all classes of electrical apparatus and devices in the heavy electric traction, power, lighting and wire communication system. Following a revision of the electrical organization of the Pennsylvania and Long Island railroads in 1932, made necessary by the large extensions of the electrification, the scope of Mr. Wells' duties was broadened and he became an active member of the electrical staff of the Pennsylvania System's organization. He is a member of the American Institute of Electrical Engineers and of various transportation associations.

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▶ CHARLES P. PFARRER, who has been connected with the legal department of the Dayton Power & Light Company, Dayton, Ohio, since 1929, has been appointed vice-president in charge of legal affairs.

OBITUARY

D. McFarlan Moore

Daniel McFarlan Moore, whose electrical researches and inventions won the recognition of Thomas A. Edison and other eminent scientists, died June 15, at the hand of an assassin. Mr. Moore was shot near the garage of his home in East Orange, N. J. He had to his credit more than 100 patents and was especially known for his invention of the gaseous conduction electric lamp, of which the neon tube is the modern example.

Mr. Moore started working on the electric light problem while he was a draughtsman working for Mr. Edison. After three years with Mr. Edison he achieved his first patent. In 1894 he organized and became vice-president and general manager of the Moore Light Company and the Moore Electric Company. After eighteen years he sold his interests to the General Electric Company and engaged in research work in its plant at Harrison, N. J. A few years ago he retired to continue his private studies.

In 1924 he invented the gaseous conduction lamp, which has since made possible facsimile photographs by radio reception. A year later he produced lamps that were the first to receive motion by radio. His 1929 developments worked important improvements in television. He was closely associated with Dr. E. F. W. Alexanderson in the development of the neon lamp in the television receiver, working with him at the General Electric laboratories in Schenectady.

Mr. Moore was a fellow of the American Institute of Electrical Engineers, a past-president of the Illuminating Engineering Society, member of the New York Electrical Society and other scientific associations.

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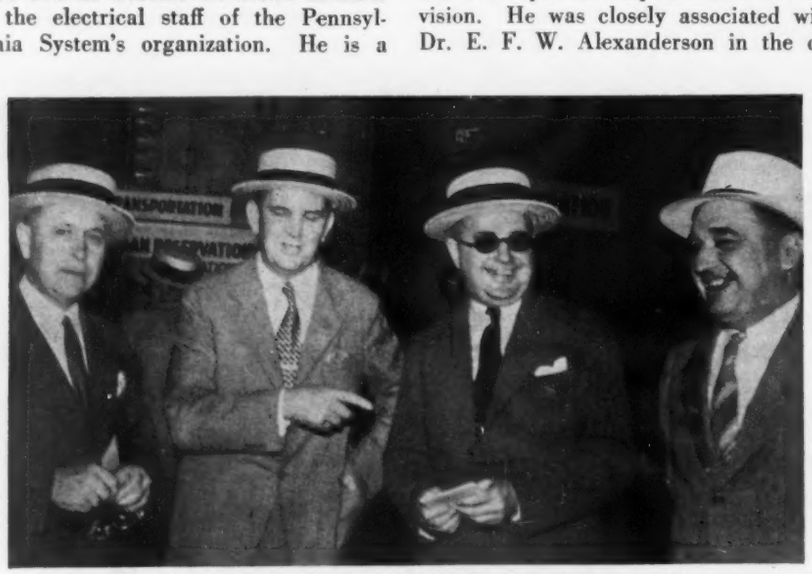
▶ FRED WEBSTER, for many years Pacific Coast manager of the Allis-Chalmers Manufacturing Company and later manager of the Chicago office of that organization, died in Los Angeles May 25, after an illness of two years.

▶ COL. EDWARD H. R. GREEN, to whose co-operation at his estate at Round Hills, Mass., the Massachusetts Institute of Technology has been much indebted in connection with the researches conducted there by Dr. Robert J. Van de Graaf in the ultra-high-voltage field, died at Lake Placid, N. Y., on June 8 at the age of 67.

▶ FARLEY CLARK, consulting engineer, died suddenly, of a heart attack, at his home in Toronto, May 31. Mr. Clark was formerly chief engineer for the Toronto Power Company at Niagara Falls, the Toronto Electric Railway and the Toronto Street Railway. Of late he had been a consulting engineer, doing research work in electrochemical engineering. He was educated at Cornell University and the Massachusetts Institute of Technology.

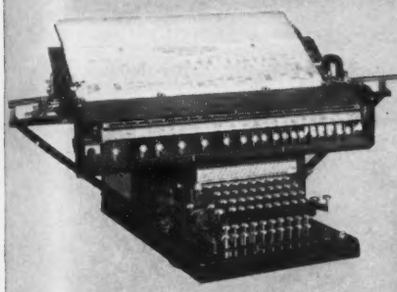
▶ FRED G. HAVLIN, assistant treasurer of the Edison Electric Illuminating Company of Boston, and for about 35 years secretary to the late president Charles L. Edgar, died at the Somerville Hospital May 28 after an operation. He entered the company's service in 1892, and in 1919 was made clerk of the corporation, becoming assistant treasurer a year later. Mr. Havlin had recently resigned these posts and had planned to retire from active business on July 1. He was widely known in New England utility executive circles.

▶ FRED E. SAWYER, power sales engineer of the Salem Electric Lighting Company and prominent in the New England Association of Central Station Power Sales Engineers since its inception 20 years ago, died suddenly at his home in Danvers, Mass., on June 7. He was born in Tamworth, N. H., 65 years ago, and after spending a few years in steam railroading entered the employ of the Salem company, which he served for 37 years. Mr. Sawyer had a flair for electrical history which gave him an unusual background in his work in industries on this former Tenney property, and he had a wide circle of friends in the New England utility area.



N. G. Symonds, Westinghouse; G. W. Hamilton, Westinghouse, Kansas City; C. C. Smith and L. Graves of Kansas City Power & Light at St. Louis

Burroughs



BURROUGHS TYPEWRITER ACCOUNTING MACHINE

Writes check (or pay envelope), earnings record, employee's statement and payroll summary in one operation. Column selection automatically controlled. All totals accumulated. This machine is only one of several models; payroll work is only one of the many jobs they do.

SIMPLIFIES PAYROLL ACCOUNTING *and gives you the additional information required by the* **SOCIAL SECURITY ACT**

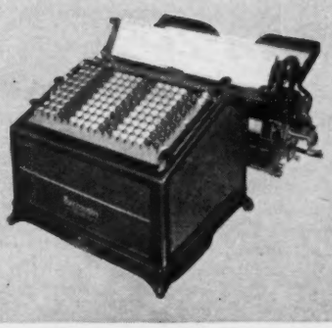
BURROUGHS DESK BOOKKEEPING MACHINE

Posts earnings records, automatically prints dates in proper columns, automatically subtracts deductions—calculates net pay. Can also be used as a fast, practical adding-subtracting machine for all kinds of accounting work. Many styles and many models—all low in price.

BURROUGHS CHECK-WRITING TYPEWRITER

Writes payroll checks in units or in strips. Payroll summary completed in same operation. Fast and easy insertion and removal of checks. Can also be used as a typewriter for correspondence and general typing. Electric carriage operation. Several models.

BURROUGHS offers many new and improved machines which not only supply the additional payroll information required by the Social Security Act, but also handle the entire payroll job with exceptional speed, ease and economy. It will pay you to investigate these new machines. Telephone the local Burroughs office, or send for the new payroll folder described in the coupon below.



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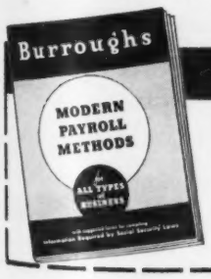
Writes check (or pay envelope), employee's earnings statement, earnings record and payroll summary in one operation. Accumulates all necessary totals, automatically ejects and stacks checks in order. Many models for payroll work, as well as for scores of other accounting jobs.



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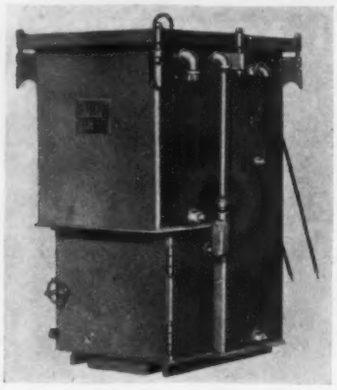
Send me the new folder "Modern Payroll Methods," illustrating complete payroll accounting methods, with typical forms for maintaining the information required by the Social Security Act. The forms show representative entries and suitable column headings.

Name_____ Address_____

NEW EQUIPMENT AVAILABLE

Feeder-Voltage Booster

This booster regulator has been designed to economically improve voltage conditions on circuits where the close regulation provided by standard station-type regulator is not necessary and where voltage control of



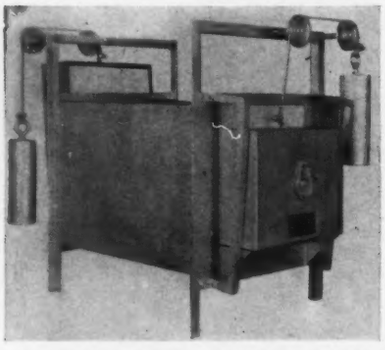
Type BR; provides 5 or 10 per cent boost in one or two steps as desired. **Westinghouse Eelctric & Mfg. Co.,** E. Pittsburgh, Pa.

any kind has been considered too expensive. It is said to be particularly applicable to lines where the load changes once or twice daily from very light to practically full load. The standard booster is outdoor type, single phase, with hanger irons for pole mounting. For three phase, three-wire circuits, two units may be connected in open delta. For three phase, four-wire circuits, three units may be connected in star.

•

Electric Furnace

Furnaces of this make are now available for operation at 2,000 deg. F. with a door at each end. Designed for special brazing work, the operators can work at either



Rated at 5 kw., 220 volts. **Harold E. Trent Company,** Philadelphia, Pa.

end of the furnace. Proper working temperatures are maintained with pyrometer control. The unit illustrated is a variation of the Type ML electric furnace.

•

Single Phase Motor

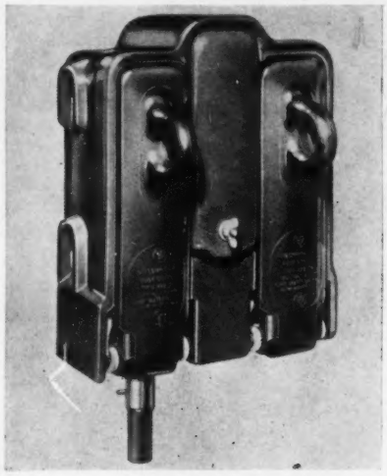
Available in sizes from ¼ to 5 hp. **Crocker Wheeler Electric Mfg. Co.,** Ampere, N. J.

Simplicity in construction and operation is featured in this new line of single phase capacitor start motors. In general, construction is the same as polyphase induction motors of this make. The same frames, end shields, shafts and squirrel-cage rotors and bearings are used. The stator winding is similar to that of a two phase induction motor. There are two windings—a main and a starting winding—spaced ninety electrical degrees apart. The main winding is connected across the line and the starting winding is connected across the line at starting in series with an electrolytic condenser. When the motor reaches about 75 percent of speed, a shunt type magnetic switch opens the circuit through the starting winding and holds this circuit open while the motor is running at normal speed.

•

Reclosing Fuse Cutout

Two single shot type "TVD" cutouts connected by an automatically reclosing transfer switch are the basic elements composing this new circuit reclosing fuse cutout. A



Type "RP"; 5,000 volt, 50 amp. capacity. **Line Material Company,** South Milwaukee, Wisconsin.

syphon-bellows time-delay provides an interval between the blowing of the first fuse and reclosing through the next adjacent fuse. Doors stay closed and cartridges drop out into telltale signal positions.

•

Rural Fuse Cutout

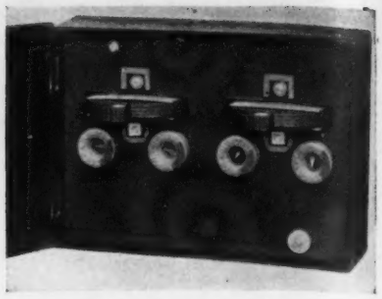
Model 9F8A1. **General Electric Company,** N. Y.

A line suspension fuse cutout especially suitable for 6,900 volt "one-line", common-neutral circuits is now announced. Designed for suspension from a "saddle" which is permanently attached to the line conductor, the cutout consists essentially of a fuse tube with a metal sleeve threaded into a "head" or terminal and clamp assembly, for connection to the line saddle. Positive indication of the condition of the fuse is given by a gravity drop indicator at the lower end of the cutout.

•

Water Heater Switch

A two circuit water heater switch recently announced consists of two 2-pole switches in one case. A dead front plate, held in place by a large nut on a slotted stud, pro-



Bulletin 4142 H2. **Cutler-Hammer Inc.,** Milwaukee, Wis.

vides a simple but adequate method of sealing to prevent wire tampering or accidental contact with live parts. Guards above the operating levers on the outside of the case provide a means of padlocking the switch in either "on" or "off" positions.

•

Tap-Off Clamps

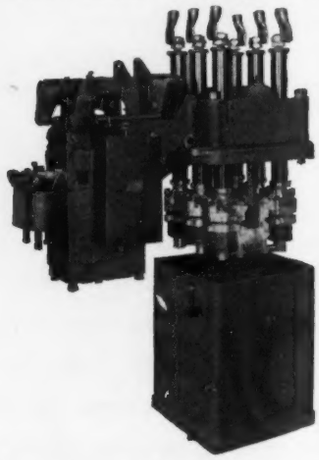
For main line wire size No. 6 to 266,800 cm.; jumper contact No. 8 to 1/0 stranded copper. **Tips Tool Company,** Taylorville, Ill.

Tap-off clamps designed for making permanent transformer connections to aluminum conductors are now available made of Alcoa aluminum and with a bronze insert to make the copper connection to the transformer lead. The main feature of the clamp is its ability to make tap connections for the transformer over the aluminum armor.

•

Oil Circuit Breaker

New indoor station type oil circuit breakers equipped with interrupting devices called "Ruptors" are claimed to give quick clearing of short circuits along with low arc energy, low pressure and a minimum of oil deterioration. Other features claimed for this equip-



For 600 and 1,200 amp. at 15 kv. and 2,000 amp. at 7.5 kv. Interrupting rating 100,000 kva. **Condit Electrical Mfg. Co.,** Boston, Mass.

ment are: enclosed, low-inertia, high-speed mechanism; internal shock absorbers; silvered contacts; oil and gas separator and Bakelain bushings.

•

Polish Rod Dynamometer

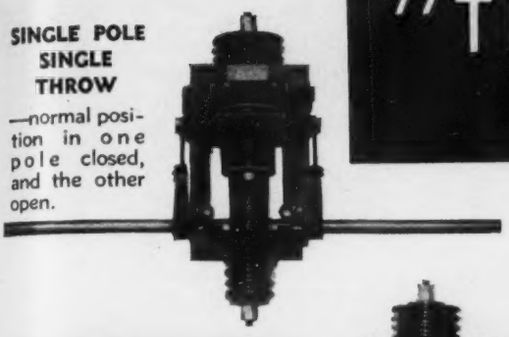
For graphically recording instantaneous polish rod loads a dynamometer, known as the Dynagraph, has been developed which is entirely self-contained and which gives a graphic record accurate within two percent. The instrument is clamped onto the polish rod below the reins. Stretch of the rod be-

"THREE E" TELESCOPING ISOLATORS

—any desired combination

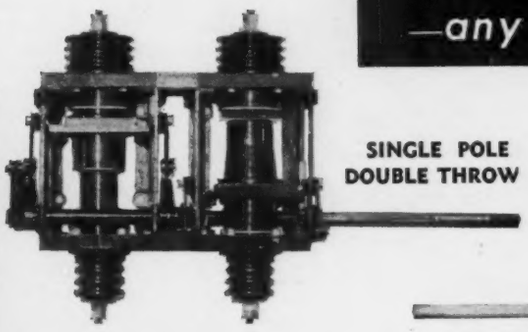
SINGLE POLE SINGLE THROW

—normal position in one pole closed, and the other open.

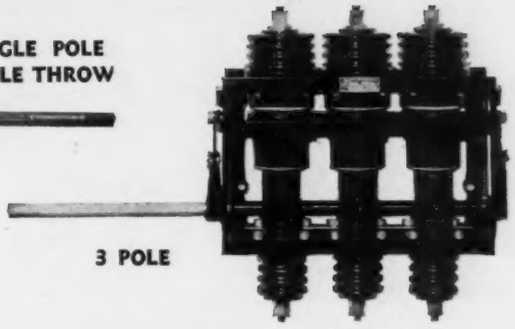


---A New Safe, Compact Device

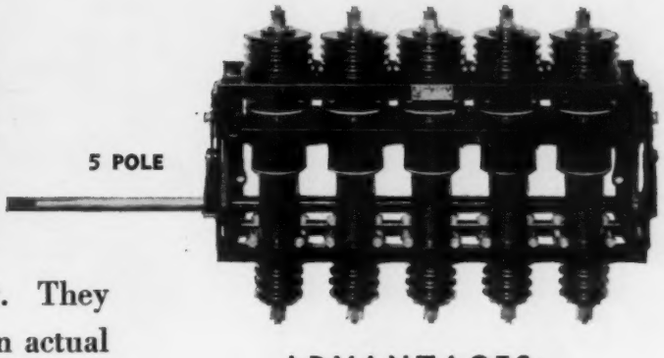
for **DISCONNECTING ELECTRICAL POWER CIRCUITS**



SINGLE POLE DOUBLE THROW



3 POLE



5 POLE

These isolators are our latest development. They have already proved their dependability in actual service. Their design is the result of years of experience in developing high tension line and station equipment.

"Three E" Isolators can be supplied for practically any kind of installation. They can be furnished for assembly with oil circuit breaker studs, transformer bushings, etc.

All live parts of the isolator are enclosed in insulation when in either closed or open position. Danger of accidental contact by operators or workmen is eliminated.

ADVANTAGES

The isolator provides a safe and compact disconnecting device by use of telescoping contacts, enclosed telescoping insulating bushings. This construction provides self-contained barriers between phases, obtained by means of the insulating bushings. This permits the phase spacing to be reduced to a minimum.

Isolator operates equally well in any required position.

Compactness means minimum space.

Installed at very low cost.

Savings made in mounting structure.

Any desired combination of single pole units, single or double throw can be made.

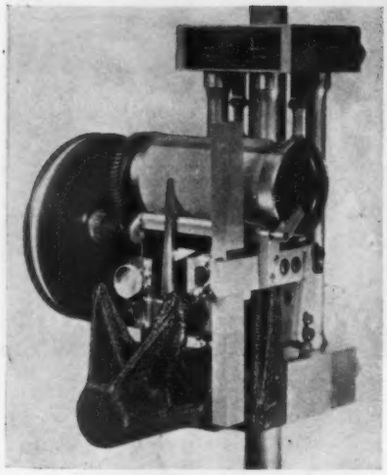
IDEAL FOR CUBICLE CONSTRUCTION

WRITE FOR BULLETIN No. 131

ELECTRICAL ENGINEERS EQUIPMENT CO.

"EVERYTHING IN HIGH TENSION EQUIPMENT"

MELROSE PARK • ILLINOIS • U. S. A.



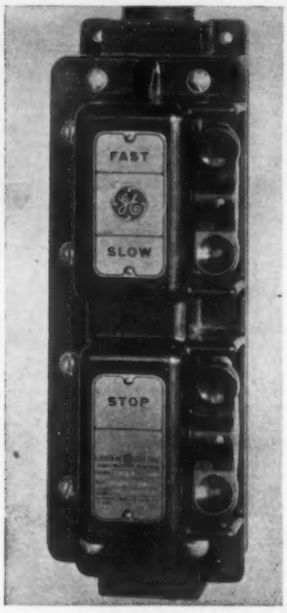
"Dynagraph." **Westinghouse Electric & Mfg. Co.,** E. Pittsburgh, Pa.

tween the clamping points is recorded on a chart which is rotating in proportion to the pumping stroke. The recording stylus is actuated by polish rod stretch, which is magnified 400 times.

•

Push-Button Master Switches

Water-tight push-button master switches, mounted in moulded phenolic-compound enclosures are intended for naval-type installations or equivalent industrial applications.



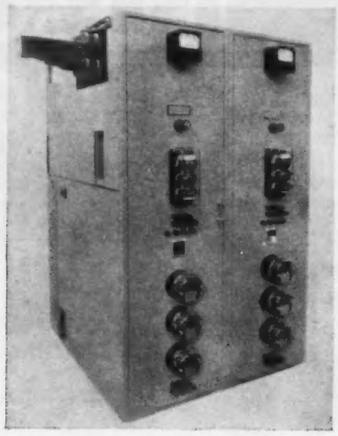
Designated as CR2940; provide both normally open and closed circuits. Either momentary-contact units or a combination of momentary contact and latched in units are to be had. **General Electric Company,** Schenectady.

Each unit is operated by a moulded-compound lever, thus protecting the operator from electrical contact with any metallic parts that might be energized. As many as four units may be mounted in one enclosure.

•

Interchangeable Metal-Clad Switchgear

Fully interchangeable metal-clad switchgear has been introduced for installation in as many sections as desired. Steel enclosed sections are mounted side by side and the main insulated buses are joined by bus sections. Two units shown are part of a six unit 4,150 volt feeder installation. Each section is equipped with a manually operated oil circuit breaker, ammeter, watthour meter and overload relays.



Delta-Star Electric Company, Chicago, Ill.

•

Multi-Ridge Insulators

Slightly more leakage surface and greater eye appeal characterize this new line of multi-ridge pintype insulators. These porcelain units, which are available in five sizes are the practical equivalent of regular standard pintype insulators for service voltages up to 23 kv.

Five sizes available; Dry arc-over voltages from 35 to 90 kv. **Ohio Brass Company,** Mansfield, Ohio.

ENGINEERING DATA FROM MANUFACTURERS

Bulletins and catalogs now available to engineers by manufacturers and associations

ROTATING MACHINERY STANDARDS—American Standards for Rotating Electrical Machinery as approved by the American Standards Association, January 6, 1936, are now available from the association headquarters, 29 West 39th Street, New York City. Copies are $1.30 each.

VULCANIZED FIBER—In a 36-page booklet which details the various uses of vulcanized diamond fiber is a section which gives, in tabular form, information on properties of fiber, allowable variations in thickness of fiber, strips, sheets, and in diameters of tubes and rods, tables of weights and other similar information of interest. Bulletins can be had from Continental Diamond Fibre Company, Newark, Delaware.

RURAL CABLE—How to select and install insulated cable for underground and overhead distribution on rural systems is outlined in bulletin GEA 2216 of the General Electric Company, Schenectady. Various types of cables for this service are listed and their advantages and properties tabulated. Recommendations, as to the proper installation procedure is described and illustrated for both underground and overhead.

ELECTRICAL STEEL SHEETS—Core loss, normal magnitization and permeability curves for a large number of electrical steel sheets are given in a 23-page bulletin of the American Sheet and Tin Plate Company, Electrical Sheet Division, Pittsburgh, Pa.

STEAM ENGINES — Sectional drawings, brake-horsepower tables, water rates, tables, engine data, specifications, erection drawings, and a complete and fully illustrated discussion of construction and design details are given in bulletin 305 (48 pages) which covers the by-product power steam engines made by Troy Engine & Machine Company, Troy, Pa.

WELDING CHART — A new engineering drafting room chart which presents in concise ready-reference form data necessary for producing arc welded designs, is announced by The Lincoln Electric Company, Cleveland, Ohio. Data on the chart include: weld symbols for working drawings; illustrations and particulars regarding the sixteen types of joints for arc welding; illustrated suggestions for better arc welded design; sketches explaining the nomenclature of welds and weld dimensions; a comparison of welded and riveted drawings; and tables giving properties of base metals, weld metals, electrode metals for hard facing, length of fillet weld to replace rivets, and safe allowable loads for fillet welds in shear.

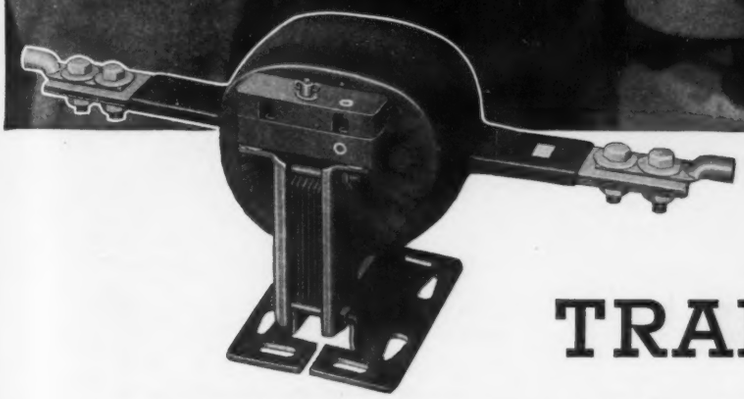
CHEMICAL ELEMENT TABLE — Atomic weight, melting point, boiling point, valence, density, crystal system, unit cell size and other characteristics of 92 elements is tabulated in this leaflet which contains data relating to X-ray work. It is available from the St. John X-Ray Service, Inc., 3020 Thompson Ave., Long Island City.

DRUM CONTROLLERS — Wiring diagrams, construction and assembly drawings, rating tables of drum controllers are included in a 12-page catalog now available from the Furnace Electric Company, West Allis, Wisconsin.

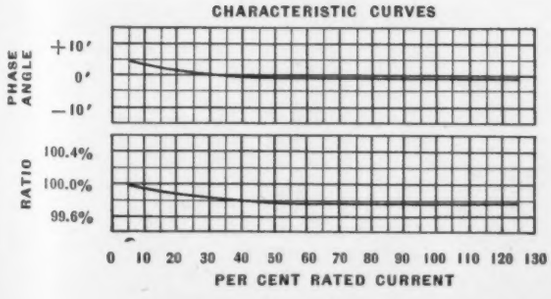
SERVICE STATION LIGHTING — Diagrams demonstrating the proper location of floodlights for optimum illumination of gasoline service stations are in a 34-page bulletin published by the Benjamin Electric Mfg. Company, Des Plaines, Ill. Similar diagrams are given to aid in the design and layout of lighting equipment for garages and auto laundries.

DEMAND METERS—Complete information on the operation, construction, characteristics, dimensions, application and cost of demand meters is given in 76 pages of catalogue GEA C of the General Electric Company, Schenectady, N. Y.

TRANSFORMERS—A 40-page catalog covering their complete line of transformers has recently been isued by the American Transformer Company, Newark, N. J. Transformers for pole platform, vault and subway service are described. A 24-page data book gives complete tabular information on standard voltage ratings and kva. sizes—viz., accessories, taps, weights, dimensions, etc.



SANGAMO Instrument TRANSFORMERS



Ratio and phase angle characteristics of instrument transformers are of utmost importance in accurate metering. . . . The characteristic curves on the left show average ratio and phase angle of Sangamo Type M-50 Current Transformers when the secondary burden consists of one watthour meter.

SANGAMO ELECTRIC COMPANY
SPRINGFIELD, ILLINOIS

GOOD poles, of high strength, with resistance to decay, and with salvage value if the line is moved, are one of the first requirements for rural electrification projects. AmCreCo poles have an enviable record for long life and can contribute substantially to the low annual costs necessary for profitable operation of rural lines. We will gladly furnish estimating data.

AMERICAN CREOSOTING COMPANY
INCORPORATED
COLONIAL CREOSOTING COMPANY INCORPORATED
AMCRECO
GEORGIA CREOSOTING COMPANY INCORPORATED
LOUISVILLE — KENTUCKY

Municipal Plants

BETHLEHEM, PA.—Counsel for the city recently argued before the Pennsylvania Supreme Court that the city had not exceeded its indebtedness in floating a bond issue to finance a municipal electric plant. City Solicitor Daniel McCarthy appealed an injunction against the proposed plant obtained by the Pennsylvania Power & Light Company. The Northampton County Court granted the injunction. The power company argued that the city could not delegate its "discretionary power of counsel to the Public Works Administration" and that the company was supplying the city efficiently with sufficient electricity. The power plant was to be a P.W.A. project.

LEXINGTON, VA.—Town council has employed engineers to make a survey of the electric power situation for the purpose of ascertaining whether or not it would be advisable to build a municipally-owned electric power plant. The engineers will also recommend a suitable site for a dam and power station giving an estimate of the cost of construction and the cost to consumers when completed.

WALKER, IOWA—Franchise of the Iowa Electric Light & Power Company was renewed for 25 years in recent election. Out of a population of 460 only 60 votes were cast and of these 37 were affirmative.

BROOKLYN, WIS.—For the third time the Wisconsin Public Service Commission has granted the village an extension of 30 days to complete acquisition of the plant of the Wisconsin Power & Light Company. The new extension was granted because of the long illness of D. V. W. Beckwith, attorney for the village.

POYNETTE, WIS.—Wisconsin Public Service Commission has denied application of the Wisconsin Power & Light Company for rehearing on the commission order extending the time three months for the village to complete acquisition of the company's electric plant. The village board failed to act within the four months given it to complete acquisition.

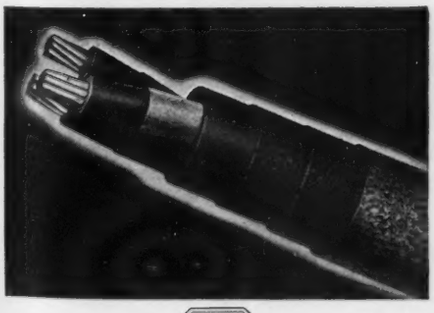
FALL RIVER, WIS.—If the village wishes to acquire the local plant of the Wisconsin Power & Light Company, it must hold a second referendum, the state supreme court in effect has ruled. The high court vacated an order of the state Public Service Commission made in July, 1934, fixing a $9,500 price on the plant on the grounds that the commission had no jurisdiction in the case. Justice J. D. Wickem, who delivered the opinion, held that the commission was without jurisdiction because the referendum question on which Fall River voted Nov. 8, 1932, was drawn under the wrong section of the statute.

ALLIANCE, OHIO—Mayor Guy E. Allott has informed City Council that he would demand a referendum at the November general election on the six-year light rate contract granted over his veto by the city to the Ohio Public Service Company.

NEWTON FALLS, OHIO—Village council is seriously considering the erection of a municipal power and light plant to supplant the purchase of electricity from the Ohio Public Service Company. Council is awaiting a final report from the Bryan and Sigmon Engineering Company before taking any definite action, although preliminary reports submitted by the engineering company indicate savings large enough to make the municipal plant economical. In the report submitted by the engineers, it is shown that a power and light plant needed to supply this village would cost about $160,000. The report also cited the possibility of a 26 per

TO "SHOW OFF" *Mother Nature*

BEFORE THOUSANDS OF TEXANS



THE City of Fort Worth installed an extensive flood lighting system to "show off" its beautiful Botanical Gardens at night. American Steel & Wire Company Non-Metallic Triple "L" Trench Cables were selected to supply current for these lights.

These Trench Cables are available in single, twin and multiple conductor constructions and in all sizes for any voltage. The insulation is our Amerite rubber which has low water absorption, perfect aging characteristics, and is in daily operation at voltages up to 13 K. V. Fibrous fillers are eliminated and replaced by an integral sheath and fillers of acid, alkali and water resisting compounds.

AMERICAN STEEL & WIRE COMPANY
208 S. La Salle Street, Chicago
Empire State Bldg., New York

Columbia Steel Company, San Francisco, *Pacific Coast Distributors.* United States Steel Products Company, New York, *Export Distributors*

UNITED STATES STEEL

Electrifying

NEWS!

REVOLITE ANNOUNCES

ELECTAPE

A SENSATIONAL NEW ELECTRICAL TAPE WITH FLEXIBLE BAKELITE COATING . . .

Electape brings a new conception of efficiency, working speed and economy to users of electrical tapes. Developed after several years of intensive research by Johnson & Johnson Laboratories for The Revolite Corporation, this improved electrical tape offers increased dielectric strength and outstanding adhesive qualities.

Soft, pliable, sturdily-woven, Electape is unique for the reason that it is coated with a smooth, flexible, durable Bakelite of exceptionally high resistance. It is waterproof and moistureproof. Electape is unequalled for coil and cable wrapping, where it affords sure protection against moisture and corrosion, for insulating and for all electrical purposes. It "stands up" amazingly under continuous voltages, adheres instantly and perfectly regardless of atmospheric conditions. Strongly resistant to destructive liquids and gases.

A "close-up" of the special Bakelite coating which gives Electape the "edge" over ordinary electrical tapes. Unusually resistant, this Bakelite is smooth, flexible, tough, waterproof.

●

Supplied in sizes of ¼ inch to 36 inches wide in 60-yard rolls.

THE REVOLITE REG. U.S. PAT. OFF. CORP.
A Subsidiary of Johnson & Johnson
NEW BRUNSWICK, NEW JERSEY

MAIL THIS NOW

THE REVOLITE CORP., New Brunswick, N. J. EW—JN
Gentlemen:
Without cost or obligation send me a USABLE free roll of ELECTAPE.

Name _____

Address _____

Town and State _____

Name of Jobber _____

cent saving in rates to the consumer while the initial cost of building the plant could be paid off by a surplus accumulating over a period of years.

•

Recent Rate Changes

TENNESSEE UTILITIES COMMISSION has postponed indefinitely the hearing on an order requiring the Memphis Power & Light Company to show cause why its power rates should not be reduced. The hearing was postponed by agreement of the company and the city. Commissioner Porter Dunlap said the case would be heard as soon as the power company can prepare certain exhibits requested by the city.

CENTRAL ILLINOIS PUBLIC SERVICE COMPANY has been ordered by the state Commerce Commission to reduce its rates, especially in the vast rural territory served by the corporation. E. F. Kelly, vice-president of the company and A. D. Stevens, its attorney, said at a conference with the commission that the utility stood ready to negotiate with the commission's staff for working out a program of cheaper rates.

SAVANNAH ELECTRIC & POWER COMPANY has announced a reduction in the residential rate for electricity and also the adoption of a new commercial rate allowing commercial customers to secure more electricity without additional cost. The reduction in the residential rate affects those customers using over 130 kw.-hrs. per month, and the effect of this reduction, H. C. Foss, president, explained, will be to reduce the cost of operation of electric ranges.

ST. JOSEPH RAILWAY, LIGHT, HEAT & POWER COMPANY has been ordered by the Missouri Public Service Commission to reduce electric rates $336,000 for consumers in St. Joseph and sixteen northwest Missouri communities. In addition, the commission called attention to a service charge of 75 cents a month and suggested that the new rate scheduled to be filed within sixty days eliminate the service charge and substitute a minimum charge.

IOWA-NEBRASKA LIGHT & POWER COMPANY'S consumers will save more than $200,000 annually as a result of lower electric rates. Under the new rates all customers using over 40 kw.-hr. and up to 200 kw.-hr. per month receive ½ cent reduction. All customers using over 200 kw.-hr. and up to 460 kw.-hr. per month receive 1 cent per kilowatt-hour reduction.

NEW YORK CENTRAL ELECTRIC CORPORATION and the New York State Electric & Gas Corporation have filed revised electric rates with the state Public Service Commission which are estimated to save consumers about $132,000 annually. The new schedules provide for lower residential rates, which contain a provision for water heating service and which will replace two present residential rates, one of which is for use in cases where a range or water heater is in regular use. The lower residential rate is estimated to save domestic users about $104,650 a year. Lower rates for general commercial service are also offered in all the territory covered by the schedules except the village of Penn Yan. The reduced commercial rates are estimated to save users $27,350 annually.

WEST VIRGINIA PUBLIC SERVICE COMMISSION has ordered Flat Top Power Company to put into effect by July 1 new electric rates for the town of Northfork. The commission estimated consumers will save between 1 and 20 per cent depending on the type of service, while commercial users will save 10 per cent. The commission ordered

Goodness that starts at the core

Photograph Courtesy Wagner Electric Corporation, St Louis, Mo.

WHEN we tell you that American Electrical Steel Sheets are the finest you can buy, we base our claims on the demonstrated performance of the equipment in which they are used.

Electrical engineers and electrical manufacturers are saving money every day by using these superior Steel Sheets in generators, transformers, motors and switch equipment. Production is easier, faster and lower in cost, because American Electrical Sheets are unvaryingly uniform in quality. Each shipment is just as ordered . . . mechanical and electrical properties are as specified. Flatness, uniform temper, low core loss and permeability are insured by the close and constant attention we give to every detail of manufacturing.

Because no one grade of sheet fits all applications, we place at your service:

American Transformer and Radio Sheets in several grades for transformers and certain types of high efficiency motors and generators.

American Dynamo and American Motor grades well suited for generators, motors and some transformer designs.

American U. S. Electrical standard for the general run of motors and is supplemented by:

American Armature, a lower grade much used in fractional horse power equipment where inductions are higher than average.

Our Electrical Sheet Division is always ready to assist you in solving problems dealing with the use of Electrical Sheets. Our literature gives performance curves of the various grades. You will find it helpful.

AMERICAN ELECTRICAL SHEETS

CARNEGIE-ILLINOIS STEEL CORPORATION · *Pittsburgh and Chicago*

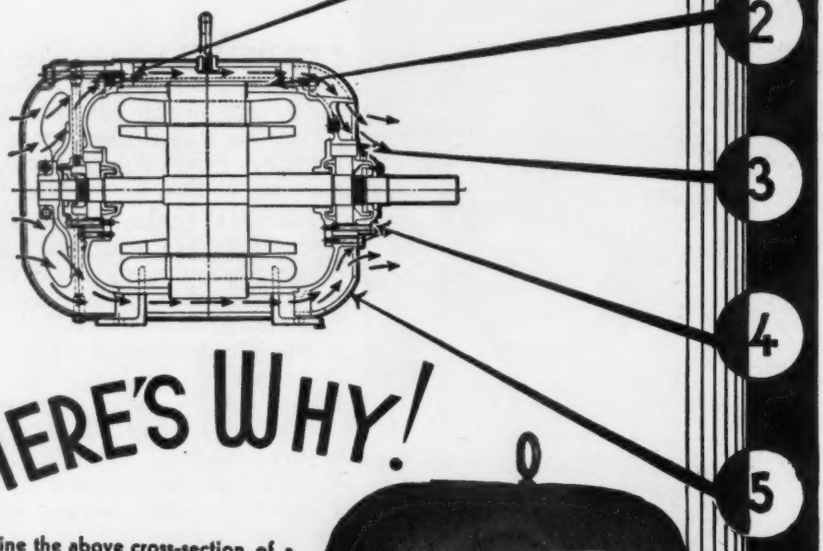
With which has been consolidated American Sheet and Tin Plate Company

Columbia Steel Company, San Francisco, *Pacific Coast Distributors*

United States Steel Products Company, New York, *Export Distributors*

UNITED STATES STEEL

Wagner Type CP Motors Require Minimum Maintenance



HERE'S WHY!

Examine the above cross-section of a Wagner type CP totally-enclosed fan-cooled motor and see why this motor, year in and year out, under all types of atmospheric conditions, will continue to carry the load—free from unnecessary shutdowns and maintenance.

Note the following salient features of design:

1. It is provided with two frames—an outer frame which guides a strong cooling draft over the motor—and an inner frame which prevents anything obstructive or injurious from getting into the motor.

2. Rugged, welded all-steel stator with specially impregnated and fully taped winding, and deeply grooved periphery to increase radiating surface.

3. Easily accessible grease plugs on both ends of motor with special arrangement on fan end to permit lubrication without removing fan shield and without shutting down the motor.

4. Full cartridge-type bearing construction which completely seals and protects the ball bearings.

5. End-plates direct the ventilating air against the bearings, keeping them very cool.

There are many other features of superiority of Wagner type CP motors. Write today for your copy of Bulletin 174, Part 5B.

Wagner Electric Corporation

6400 Plymouth Avenue, Saint Louis, U.S.A.

MOTORS FANS TRANSFORMERS BRAKES

ML336-1B

the company to supply service through one meter to each customer where possible, and if two meters are used, to combine the readings.

MISSISSIPPI POWER COMPANY has announced a new promotional commercial rate effective June 1.

TIDEWATER POWER COMPANY'S consumers in southeastern North Carolina will be saved $53,205 annually in rate reductions. Principal reductions, Chairman Stanley Winborne of the state utilities commission, said, will be in New Hanover County where cuts will range from 7 to 20 per cent, the greater reductions to accrue to the small customer. More profitable business by the company, due principally to a greater density of population in Wilmington and its environs, made possible the reductions.

WILLAPA ELECTRIC COMPANY, Willapa, Wash., has granted rate reductions of approximately $12,500 yearly for its customers.

BOOK REVIEWS

Alternating-Current Machines

By A. F. Puchstein and T. C. Lloyd. John Wiley & Sons Inc., New York. 582 pages, illustrated. Price, $5.

This is a text on alternating-current machines that is a combination of theory and design. It follows a logical method of treating construction, operating characteristic, calculation of characteristics and analysis of detail and related phenomena. One of the best features is a carefully selected bibliography that permits further study and reading on each chapter. Machines treated are synchronous generators, transformers, polyphase induction motors, single-phase motors, synchronous motors, alternators in parallel, synchronous converters, rectifiers and series and repulsion motors. The book is well written, with a happy balance between design, theory and test.

•

Public Utility Atlas

The Journal of Commerce, New York. 32 pages, illustrated. Price, $25.

This is a series of state maps showing light and power properties and population densities. It gives the power stations, the transmission lines, capacities, interconnections, local property names, holding company affiliations and the density of population by use of shaded areas. This atlas should be very useful to investment houses, utility executives and students of the utility industry. The large plate maps are well done and are very legible and are copyrighted by Institutional Utility Service, Inc.

•

Mathematics of Modern Engineering

By R. E. Doherty and E. G. Keller. John Wiley & Sons, Inc., New York. 314 pages, illustrated. Price, $3.50.

This unusual book is devoted to the mathematics that have been found most useful in engineering practice and is featured by the tangible method of approach to use mathematics to solve practical problems in mechanical and electrical engineering. It stresses the formulation of the problems in

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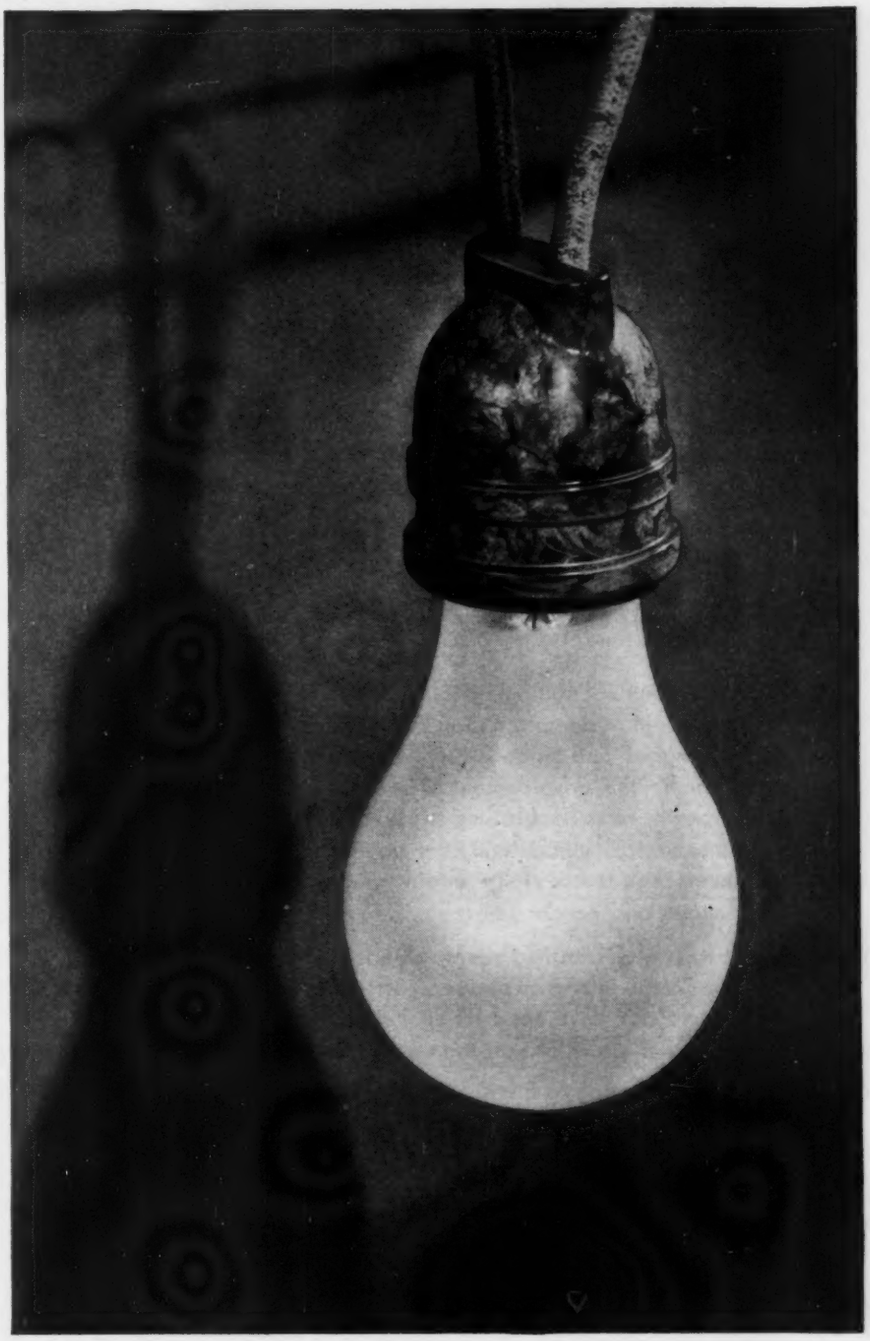

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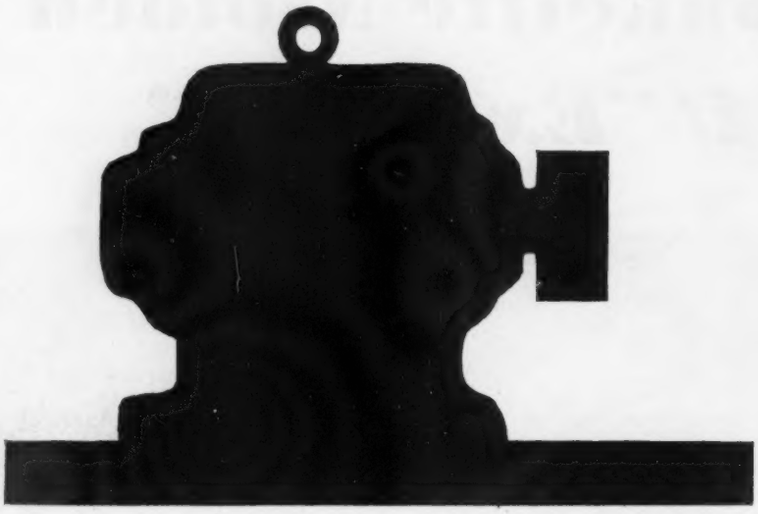

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mathematical terms and then the use of the proper solutions. Its scope covers broadly advanced problems in electrical and mechanical engineering and is based upon advanced teaching experience with graduate students in engineering.

Basic mathematics through differential equations are followed by more special uses of Fourier series, higher degree and transcendental equations, dimensional, graphical and vector analysis, vector fields, dyadics and operational calculus. The use of the book is premised upon a normal undergraduate course in mathematics. It should be very useful to specialized engineers and to graduate students.

•

Living Together in a Power Age

By Samuel S. Wyer. Published by Association Press, 347 Madison Avenue, New York City. 250 pages, charts. Price, $2.50.

Foundation for the three closing chapters of plans for "living together" successfully rests on the premise that the engineer "quietly and blindly and without appreciation of the social implications, by harnessing the energy in our natural resources, has unleashed new forces which started the world's worst economic muddle." But, with a comprehensive round-up of facts, the author finds 38 other factors that share the honors with the engineer for messing things up. Most of these are analyzed tersely in what follows.

In the electric chapter, the author displays the capacity for graphic elucidation for which he is noted. He is equally emphatic in many of his assertions about rate inequities and holding company improprieties. Not that he is at all a government ownership advocate, for he is not—"we must not be less hard hearted in talking about the possibilities of government ownership than of private ownership."

Among the specifics for routing depressions are the elimination of all doles, even tariff doles to selfish business, subjection of all executive and bureaucratic orders to court review, banning of war profits, old-age pensions, lower interest rates, more to workers and less to capital. But above all, a planning board is needed to work out the prevention of another debacle. The final chapter lays out the details of such a board and its first agenda.

•

Year Book, American Bureau of Metal Statistics, 1935

Published by American Bureau of Metal Statistics, 33 Rector Street, New York. 118 pages. Price $2.

This compilation, of which the present one is the sixteenth annual issue, carries the data on non-ferrous metals through 1935. Available statistics differ for the various metals and this difference is necessarily reflected in the tables. The most thoroughgoing are those for copper. They include figures on production, consumption and stocks, by countries and in the United States the smelter output by states, exports and imports, lists of smelters, refineries and principal sellers, monthly prices in New York and London, and estimated use of copper in the United States allocated under 23 different heads, several of them relating directly to the electrical industry. This copper section comprises 33 pages; lead and zinc each about 20 pages, gold and silver 13, other metals the remainder.

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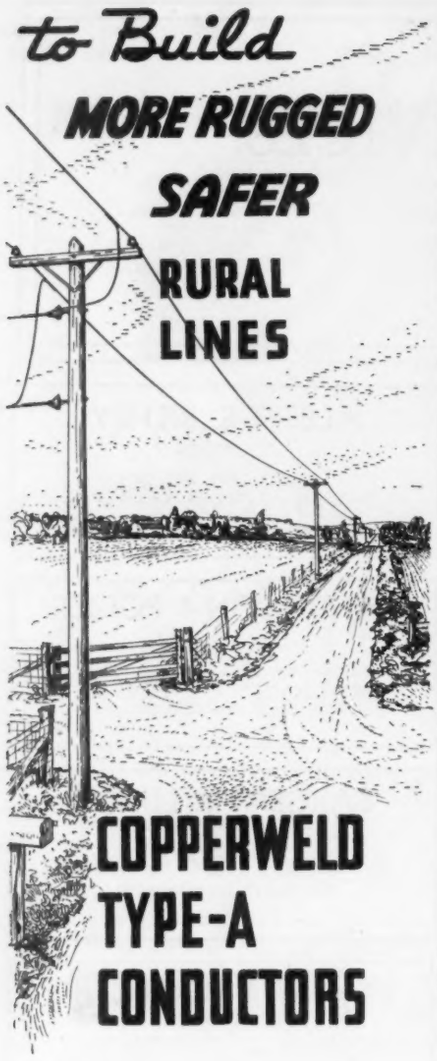

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COPPERWELD STEEL COMPANY
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Lighting Load de Luxe

[*Continued from page 31*]

in diameter and a 16-ft. shell-and-tube water cooler 28 in. in diameter. Compressors, condensers and pumping equipment are installed in the basement. From each of the two water coolers refrigerated water is pumped to York air washers which condition various zones in the building.

Thus, the main floor offices are served by one air washer and the second floor offices by another. Each one is designed to maintain a summer condition which is predicated on outdoor temperature variations, so that people entering or leaving the building will not be subjected to any unpleasant "shock." This is done by employing differential thermostats which are set so that when the outside temperature is 70 deg. F. the indoor temperature will be 72 deg. F., and for each 3-deg. increase in outdoor temperature the indoor temperature will be increased 1 deg. F.

Office air-conditioning system

The air washer for the main floor is installed in the basement with the two compressor units and conditioned air is supplied to ducts furred in above the hallways to be distributed to the various offices, lobby and corridors. Air is returned from these offices through grilles in the lower part of the office doors into the hallways, from which it is drawn, with some fresh air, back to the air washer.

The second floor is similarly conditioned by an air washer installed in a penthouse on the roof. From this point insulated air supply ducts running across the roof distribute the conditioned air to plaques in the second floor ceiling. Air is returned to the washer for reconditioning from grilles at the floor line of the west end of the building.

The first system was based on a lighting load of 2½ watts per square foot of floor area, a population load of 167 people in the third floor offices, 268 in the second floor offices and an electric light load of 10,000 watts.

A minimum of 15 cu.ft. of outside air per person per minute is introduced in the office to insure freshness, with a complete change of air every eight minutes.

The air-conditioning system installed to handle the printing department in the rear of the building is similar to the first in compressor capacity (135 tons of refrigeration), but has in addition a well water, air-cooling system.

Each office is provided with a wall type of electric clock operating on the lighting system, and conveniently located below it is a weather indicator supplying the psychological need for knowing at all times what the outside weather conditions are by means of a small panel having three colored glass bullseyes and miniature electric bulbs behind each. A chart will interpret the different color combinations and provide for the fact that people working in a building containing no windows will invarably wonder as to the weather.

Weather indications are told by three lights, operating during business hours each of a different color, by which seven combinations of lights can be had. Each of these seven combinations of color will indicate a different condition of outdoor weather. White, green and red colors are used. This is what they indicate:

White .....Clear Red .....Rain
White and red . . . Cloudy Green . . . Snow
Green and white....Clear with snow on ground
Green and red ....Snowing, with snow on ground
Red, white and green ..These three colors combined used only ten minutes before quitting time. They suggest umbrellas or raincoats and overshoes.

Conclusion

Like the Sears-Roebuck store in Chicago, the Hershey building is without windows, without drafts, without wood and almost without noise. Further, it is without desk lamps, without shadows, without glare and apparently without dust cloths, mops and brooms.

Strange as it may seem, the building is by no means a millionaire's toy.

"It costs more to erect a building with windows," says F. R. Murrie, president of the Hershey Chocolate Corporation. "Think of the cost of special masonry around the window openings, sash frames, glass, screens, awnings, etc." Operating costs are lower, and in fact the company's goal is a 25 per cent saving in operating cost by

1. Reduced heating and cooling costs, elimination of heat leakage.

2. Lessened noise and other distractions, both internal and external.

The daily consumption of 3,720 kw.-hr. per day corresponds roughly to the usage of 1,800 domestic customers, and this load with its daily load factor of 41 per cent is a piece of business to intrigue any utility company.

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Facts on Distribution Costs

[*Continued from page 34*]

distribution is of the order of ten times or more that of overhead. Overhead lines can be improved in appearance and they can give very satisfactory service. Considerable thought should be given a situation before changing to underground if economy is an object. The Detroit Edison Company, for example, has saved a considerable investment in the preliminary stages of its installation of a secondary network by leaving the transformers and a large part of the secondaries overhead until underground installations become really necessary. Perhaps a little more spent in improving the appearance of overhead lines in some cases may forestall demands for its removal and hence be well justified.

Study economics of all equipment failures

It is important, in considerations of economy, that the distribution engineer have the proper attitude toward failures of equipment or service which do occur or which he thinks might occur. Naturally, it is highly desirable to prevent failures when it is feasible to do so. There is a tendency in some quarters to feel that, whenever a failure does occur, something must be done immediately to prevent its ever occurring again. In fact, if records are studied and the theory of probability applied, it may be found that that particular kind of failure will very likely not occur again within his lifetime. On the other hand, there will probably be situations frequently on his system where trouble is much more likely and which are not being given any particular attention. A proper balance in thinking in this regard is needed to prevent unjustified expenditures in doubling the strength of some part which has broken from some unusual defect, providing throwover lines or networks for customers who can and will stand the occasional short outage which they experience, or introducing new and untried gadgets on the system which may eventually cause more trouble and expense than that which they are supposed to prevent. In this regard, let a word be said for simplicity of design. In general, the simpler and more standard the distribution system can be kept, with due regard to good operation and good service, the better.

There is no doubt that the requirements of good service are increasing. This is the result of several factors, the customer's greater use of electricity, his being accustomed to high quality of service, and improvements in system design and operation. Better service, in general, will naturally follow increasing load due to the increasing revenue and the increasing importance of the load. On the other hand, it should be recognized that, other things being equal, the better the service the higher the cost of distribution. Hence, the standards which a company expects to live up to should be carefully set with due regard to reasonableness in connection with the type of load served. The three main elements of good service—good voltage regulation, good continuity of service and a minimum of flicker—can all be given customers practicably and must be beyond the limits which would cause complaints. Unreasonable demands for any of these can only be met by additional cost. An economical distribution system will be based on reasonable standards fitted to the type of load served.

Conclusion against use of arbitrary yardsticks

Summarizing, this paper has attempted to show something of the actual importance of distribution costs and the way these costs are divided among various elements of construction, indicating where economies may best be made. Betterments to service and reductions in costs are possible on most systems, especially those where less attention has been paid to distribution engineering. This is not a simple process, however, and requires careful and understanding application of the best principles of engineering, rather than arbitrary yardsticks. Major cuts in cost are not to be anticipated on present systems which have been well designed. The process of making economies is, rather, a job of "whittling" relatively small percentages off the various items of which the whole system is, and must be, composed. The results obtained will, in many cases, be surprisingly worth while.

NOTE — This is one of the series of articles on distribution representing the studies made by the Edison Electric Institute subcommittee on distribution. These authors know whereof they write.—Editors.

"WHETHER IT'S 24 GAUGE SHEET OR 3-IN. SLAB... I WANT SPEEDY WELDING!"

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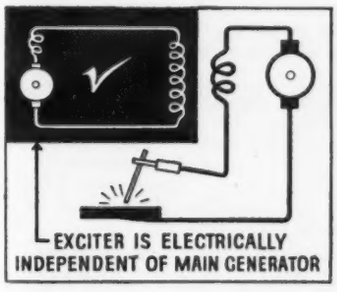
Technically Speaking

During the welding process, conditions within the arc are continually changing. The degree to which the welding generator "keeps up" with these changes affects, to a large extent, the ease of handling the arc and hence the speed of welding in order to secure welds of the highest quality.



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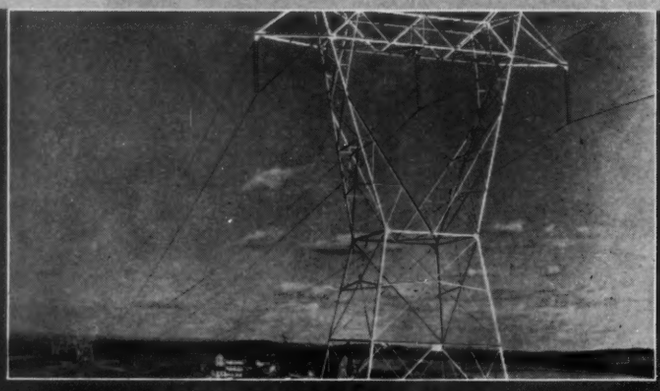

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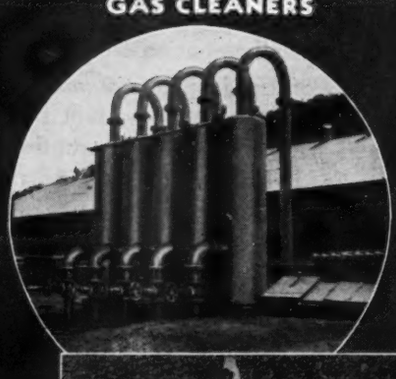
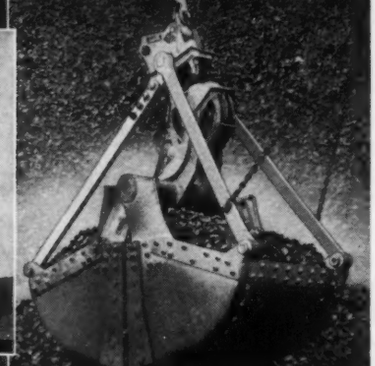


STEEL BUILDINGS



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SALES OPPORTUNITIES IN NEW CONSTRUCTION

SACRAMENTO, CALIF. — Has plans maturing for new electrical distributing system, including extensions in neighboring territory, with power substation, switching station and other facilities. Cost about $12,000,000, of which $5,400,000 is being secured through Federal aid.

ANDERSON, IND. — Guide Lamp Company, manufacturer of automobile headlights, plans installation of motors and controls, conveyors and other equipment in new addition to plant, 280x400 feet. Cost about $250,000. Company is a unit of General Motors Corporation, New York, N. Y.

KANSAS CITY, KAN.—Board of Public Utilities, City Hall, Charles A. Lowder, secretary, receives bids until July 1 for 6,000-hp. high-pressure boiler unit and accessory equipment (Contract No. 1); until July 8 for one 37,500-kva. turbo-generator unit, with auxiliaries (Contract 2); and at last noted time, for 40,000 sq.ft., condenser unit, with accessory equipment (Contract 3), for municipal electric light and power station. Extensions and improvements will be made in plant to cost about $1,500,000, including equipment. Burns & McDonnell Engineering Company, 107 West Linwood Boulevard, Kansas City, Mo., is consulting engineer.

KNOXVILLE, TENN.—TVA, Director of Purchases, receives bids until June 23 for steel transmission towers for proposed new power line from Chickamauga Dam to Watts Bar Dam.

LITCHFIELD, MINN.—Meeker Co-operative Light & Power Association, Litchfield, Irving Clinton, secretary, receives bids until June 27 for rural electrical distributing system, totaling 125 miles, including connections and facilities for power supply from local municipal power plant. Financing has been arranged through Federal aid. H. McDonald is engineer.

PONTIAC, MICH.—Pontiac Motor Company plans installation of motors and controls, conveyors, electric hoists and other equipment for expansion in automobile axle manufacturing works. Cost over $500,000. Company is a subsidiary of General Motors Corporation, New York, N. Y.

BALTIMORE, MD.—Purchasing and Contracting Officer, Holabird Quartermaster Depot, Baltimore, receives bids until June 24 for quantity of electrical supplies, including wire, switches, insulators, carbon brushes, cable, fuses, condulets, etc. (Circular 169).

HUNTLEY, MONT.—Huntley Project Development Association, Huntley, recently organized, plans transmission and distributing lines in Yellowstone and Big Horn Counties for rural electrification, totaling about 110 miles, with power substation and service facilities. Power will be secured at wholesale from Montana Power Company. Fund of $130,000 has been secured through Federal aid. Work scheduled to begin soon.

IOWA CITY, IOWA—Has plans maturing for new city-owned electric power plant and electrical distributing system. Fund of $915,000 is being arranged through Federal aid. Burns & McDonnell Engineering Company, 107 West Linwood Boulevard, Kansas City, Mo., is consulting engineer.

PORT COLBORNE, ONT.—International Nickel Company, 67 Wall Street, New York, N. Y., plans installation of motors and controls, transformers and accessories, conveyors, electric hoists and other equipment for expansion in electrolytic nickel refining plant at Port Colborne, to increase output about 50 per cent. Cost over $1,000,000.

WILSON, N. C.—Wilson County Electric

Membership Corporation, recently chartered, plans transmission and distributing lines for rural electrification in Wilson County, totaling about 129 miles, with service facilities. Fund of $160,000 has been secured through Federal aid.

WASHINGTON, D. C. — United States Engineer Office, Navy Building, Washington, receives bids until June 24 for 40 miles of copper-covered steel telephone wire (Circular 95).

BOONE, IOWA—Iowa Electric Light & Power Company, Cedar Rapids, Iowa, plans extensions and improvements in power plant at Boone, including electrical distributing lines in that district. Cost about $100,000. Work will begin as soon as renewal of franchise is secured, for which negotiations are now under way.

JANESVILLE, WIS. — Chevrolet Motor Company, Fisher Body Division, Industrial Avenue, plans installation of motors and controls, conveyors, electric hoists and other equipment in new one-story plant addition. Cost over $400,000. Albert Kahn, Inc., New Center Building, Detroit, Mich., is architect and engineer. Company headquarters are at Detroit; it is a subsidiary of General Motors Corporation, New York, N. Y.

GLENCOE, MINN.—Receives bids until June 30 for municipal electric power plant, including Diesel engine-generating units and auxiliaries; also for electrical distributing system. G. M. Orr & Company, Baker Building, Minneapolis, Minn., are consulting engineers.

BROOKLYN, N. Y.—Bureau of Supplies and Accounts, Navy Department, Washington, D. C., receives bids until June 23 for one motor-generator set, and three sets of brushes for generator, for Brooklyn Navy Yard (Schedule 8128).

GREENWICH, CONN. — Electrolux, Inc., Old Greenwich, plans installation of motors and controls, conveyors and other equipment in new three-story addition to vacuum-cleaner manufacturing plant. Cost close to $100,000.

MARSHALL, MO.—Receives bids until June 29 for extensions and improvements in city-owned electric power plant, including new 1,500-kw. steam turbo generator unit, steam condenser unit, boiler, stoker and economizer, switchboard and accessory equipment, storage battery and charging apparatus, combustion control equipment, overhead crane and hoist, etc. Cost about $215,000. Henry-Lowry Engineering Company, 114 West Tenth Street, Kansas City, Mo., is consulting engineer.

MEMPHIS, TENN.—Armour & Company, Union Stock Yards, Chicago, Ill., plan installation of motors and controls, conveyors and other equipment for expansion and modernization of cottonseed oil mill at 1701 Thomas Street, Memphis, formerly property of Memphis Cotton Oil Mill, recently acquired. Cost about $100,000.

BLAIR, NEB. — Nebraska Power Company, Omaha, plans extensions in transmission lines for rural service in portion of Washington County, vicinity of Blair. Company will also make extensions in transmission lines in Cedar Bluffs, Neb., district, for similar purpose, including improvements in present lines. Permission has been secured.

Electromaster Dividend

Directors of Electromaster, Inc., Detroit, makers of Electromaster electric range and water heater, has announced a dividend of 12½ cents per share on the company's common stock. The announcement stated that this dividend is payable on July 1 to stockholders of record as of June 15.

HIGHWAY BODIES
HAVE DEPENDABLY SERVED UTILITY CONSTRUCTION and MAINTENANCE NEEDS FOR YEARS

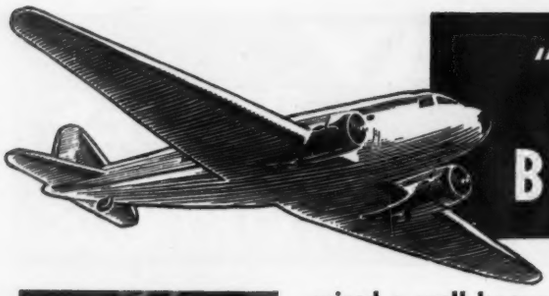
The Highway organization has always been able to meet the demands of various public utilities in their varying needs for maintenance, service, and construction bodies. Engineers, well versed in utility problems, have designed bodies with a view to durability and appearance as well as accessibility and convenience. No matter what your requirements are, there is a Highway body most economically adaptable.

This new Type LCW is of all steel construction using rust-resisting, galvanealed metal in the compartments and panels. All through its design it represents years of experience in body arrangement and construction. It is rugged and light in weight. It is designed so as to afford the utmost in convenience. There is ample room for tools and various materials and is otherwise built to serve the widest range of utility needs.

Write for bulletin showing our large line of bodies, including Type LCW featured here.

Ask for the Highway Catalog showing complete line of Earth Boring Machines, Winches, Trailers, and Derricks.

HIGHWAY TRAILER CO.
EDGERTON WISCONSIN



"RUSH 3 BY PLANE"

wired a well-known utility during the recent flood emergency, and that is the way they went.

When the unexpected happens, Tong Tests are invaluable in locating troubles in motors, cables, transformers, etc. But they are even more valuable in every day service because these instruments enable you to measure any A.C. or D.C. current instantly, accurately and without breaking the circuit. When periodically checked, electrical equipment seldom gives trouble.

Tong Tests are inexpensive and measure currents up to 800 amperes. May we send you a copy of the new bulletin describing these precision-built instruments?

THE COLUMBIA ELECTRIC MFG. CO.

4529 Hamilton Ave. Cleveland, Ohio

In Canada: Bepco Canada, Ltd., Montreal

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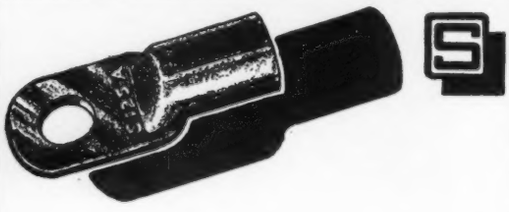
Depend on

SHERMAN SOLDERING LUGS



A correct style and size for every purpose. Carefully and accurately made of purest copper. Better conductivity. Solder can't leak out. Good appearing. Uniform. No burrs. Write for bulletin No. 6.

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H. B. SHERMAN MFG. CO., BATTLE CREEK, MICHIGAN

PRODUCT INDEX

AIR COMPRESSORS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

AIR-CONDITIONING EQUIPMENT
General Electric Co., Schenectady, N. Y.
Kelvinator Corp., Detroit, Mich.
Westinghouse E. & M. Co., E. Pittsburgh, Pa.

ALLOYS, COPPER
Mallory & Co., P. R., Indianapolis, Ind.

AMMETER, CLIP-ON
Columbia Elec. Mfg. Co., Cleveland, Ohio
Ferranti Electric, Inc., New York, N. Y.

ANALYSES, REVENUE
Recording & Statistical Corp., New York, N. Y.

ANCHORS, GUY
Chance Company, Centralia, Mo.
Everstick Anchor Co., Fairfield, Iowa.
Hubbard & Co., Pittsburgh, Pa.
Kearney Corp., James R., St. Louis, Mo.
Line Material Co., South Milawukee, Wis.

ANNUNCIATORS
Cory Corp., Chas., Brooklyn, N. Y.

APPLIANCES, HEATING
General Electric Co., Schenectady, N. Y.
Graybar Electric Co., New York, N. Y.

BATTERIES, STORAGE, ALL APPLICATIONS
Electric Storage Battery Co., Phila., Pa.
Philadelphia Storage Battery Co., Phila., Pa.

BATTERIES, STORAGE, AUTOMOTIVE
Firestone Tire & Rubber Co., Akron, Ohio
Philadelphia Storage Battery Co., Phila., Pa.

BLOCKS, LINEMEN'S CABLE STRINGING
Western Block Co., Lockport, N. Y.

BOILERS, STEAM
Babcock & Wilcox Co., New York, N. Y.
Combustion Engineering Co., New York, N. Y.

BRACKETS & WIREHOLDERS, INSULATED
Hubbard & Co., Pittsburgh, Pa.
Line Material Co., South Milwaukee, Wis.
Porcelain Products, Inc., Parkersburg, W. Va.
St. Louis Malleable Casting Co., St. Louis, Mo.
Utilities Service Co., Allentown, Pa.

BRASS AND BRONZE
Bridgeport Brass Co., Bridgeport, Conn.

BRUSHES, CARBON
National Carbon Co., Cleveland, Ohio

BURNERS, OIL, GAS, PULVERIZED FUEL
Babcock & Wilcox Co., New York, N. Y.
Combustion Engineering Co., New York, N. Y.

BUS BAR SUPPORTS
Burndy Engineering Co., New York, N. Y.
General Electric Co., Schenectady, N. Y.
Schweitzer & Conrad, Inc., Chicago, Ill.

BUS BARS & TUBES
American Brass Co., Waterbury, Conn.

CABLE ALUMINUM
Aluminum Co. of America, Pittsburgh, Pa.
General Cable Corp., New York, N. Y.

CABLE, NETWORK
Anaconda Wire & Cable Co., New York, N. Y.
American Steel & Wire Co., Chicago, Ill.
Crescent Ins. Wire & Cable Co., Trenton, N. J.
Rockbestos Products Corp., New Haven, Conn.

CABLE, PAPER INSULATED
American Steel & Wire Co., Chicago, Ill.
Anaconda Wire & Cable Co., New York, N. Y.
General Cable Corp., New York, N. Y.
General Electric Co., Schenectady, N. Y.
Kennecott Wire & Cable Co., Phillipsdale, R. I.
Okonite-Callender Cable Co., Passaic, N. J.
Roebling's Sons Co., J. A., Trenton, N. J.
Simplex Wire & Cable Co., Boston, Mass.

CABLE, PARKWAY
American Steel & Wire Co., Chicago, Ill.
Anaconda Wire & Cable Co., New York, N. Y.
Crescent Ins. Wire & Cable Co., Trenton, N. J.
General Cable Corp., New York, N. Y.
Kerite Ins. Wire & Cable Co., New York, N. Y.
Okonite Co., Passaic, N. J.
Roebling's Sons Co., J. A., Trenton, N. J.
Simplex Wire & Cable Co., Boston, Mass.

CABLE SERVICE ENTRANCE
Crescent Ins. Wire & Cable Co., Trenton, N. J.
Simplex Wire & Cable Co., Boston, Mass.

CABLE, STEEL STRAND
American Steel & Wire Co., Chicago, Ill.
Indiana Steel & Wire Co., Muncie, Ind.
Roebling's Sons Co., J. A., Trenton, N. J.

CABLE, SUBMARINE
American Steel & Wire Co., Chicago, Ill.
Anaconda Wire & Cable Co., New York, N. Y.
General Cable Corp., New York, N. Y.
General Electric Co., Schenectady, N. Y.
Kerite Ins. Wire & Cable Co., New York, N. Y.
Okonite Co., Passaic, N. J.
Roebling's Sons Co., J. A., Trenton, N. J.
Simplex Wire & Cable Co., Boston, Mass.

SEARCHLIGHT SECTION

EMPLOYMENT : BUSINESS : OPPORTUNITIES : EQUIPMENT—USED or RESALE

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1 inch	$7.00
2 to 3 inches	6.75 per inch
4 to 7 inches	6.50 per inch
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An advertising inch is measured vertically on one column, 3 columns—30 inches—to a page. E.W.

COPY FOR NEW ADVERTISEMENTS RECEIVED UNTIL 10 A.M. MONDAY FOR SATURDAY'S ISSUE *(published every other week)*

POSITION VACANT

DESIGN ENGINEER wanted by manufacturer of electrical products: technical graduate preferred; must be capable of designing apparatus with attention to production economies; permanent position; give full qualifications in first letter. P-487, Electrical World, 520 No. Michigan Ave., Chicago, Ill.

EMPLOYMENT SERVICE

SALARIED POSITIONS, $2,500 to $25,000. This thoroughly organized advertising service of 26 years' recognized standing and reputation carries on preliminary negotiations for positions of the caliber indicated, through a procedure individualized to each client's personal requirements. Several weeks are required to negotiate and each individual must finance the moderate cost of his own campaign. Retaining fee protected by a refund provision as stipulated in our agreement. Identity is covered and, if employed, present position protected. If you have actually earned over $2,500, send only name and address for details. R. W. Bixby, Inc., 262 Delward Bldg., Buffalo, N. Y. (E. W.)

POSITIONS WANTED

RATE ENGINEER, graduate, experienced, now employed, available short notice, capable to organize and develop rate and statistical studies. Salary $350.00. PW-485, Electrical World, 330 West 42d Street, New York City.

POSITIONS WANTED

ELECTRICAL ENGINEER with three years' practical experience in steel and copper plants, seventeen years in sales engineering and sales management and record of accomplishments, seeking position with reputable manufacturer. PW-486, Electrical World, 520 No. Michigan Ave., Chicago, Ill.

SELLING OPPORTUNITIES
OFFERED—WANTED
Selling Agencies—Sales Executives
Salesmen—Additional Lines

OPPORTUNITIES WANTED

POWER SALES ENGINEER desires change; ten years with large utility, four years as power sales manager working with City Councils, combating competition and securing new business. Westinghouse factory training, technical graduate engineering, age 35, married, go anywhere. Available thirty days. SA-484, Electrical World, 520 No. Michigan Ave., Chicago, Ill.

OPPORTUNITIES WANTED

SALES PROMOTION—20 years' intimate contact with executives and operating department heads of utilities and industrials from coast to coast; first-hand knowledge of their engineering practices, requirements and attitudes towards manufatcurers; and many years' experience as managing editor of technical magazine. Qualified to handle customer-relations contacts, create welcome reception for salesmen, break down sales resistance, prepare and present papers before industrial groups, stimulate current business and market development, minimize tendency to buy on price alone, develop replacement-parts business, secure more effective publicity in industrial and engineering magazines, unearth sales ammunition based on owner-benefits, conduct company house organs addressed to prospects, etc. SA-482, Electrical World, 330 West 42d Street, New York City.

ANNOUNCEMENT!
Real Representation Offered

Offices have been opened by two experienced representatives in Atlanta, Knoxville, and Charlotte to represent manufacturers of transmission, distribution and line material. Already serving nationally known accounts. If you are not already represented in the Southeast or are dissatisfied with present arrangements write us *now* as only a few additional lines will be considered.
RA-489, Electrical World, 330 W. 42d St., N. Y. C.

Who Makes
the "X" Transformer?

How often have you found difficulty in learning the name of the maker of a certain brand of transformer, switch or other electrical or allied product?

With the Buyers Reference Number of Electrical World you can locate this information quickly and easily by simple reference to the alphabetical Index of Company and Trade Names.

You will also find the classified index of products most helpful in locating the maker of a certain product. Keep this book handy in planning your future buying.

ELECTRICAL WORLD, 330 W. 42d St., New York, N. Y.

Headquarters for Everything Electrical

OFFICIAL PROPOSALS

Bids: June 29.

Substations

North Platte, Neb.

Sealed bids will be received by the Platte Valley Public Power and Irrigation District, North Platte, Nebraska, for the furnishing of miscellaneous materials for, and the erection of, five substations for the Sutherland Project, located in Lincoln, Red Willow, Buffalo and Merrick Counties, Nebraska, until 10 o'clock a.m., June 29, 1936, in the office of the Secretary of said District, at which time and place said bids will be publicly opened and read.

The work will consist of grading the substation sites; excavation for, and construction of, concrete foundations and duct-runs; erection of steel tower structures; furnishing certain electrical materials; installation of all electrical materials and apparatus; furnishing and erection of fencing, gravel paving, drainage, and other collateral items.

Plans and specifications may be secured from the Secretary of the District at North Platte, Nebraska.

PLATTE VALLEY PUBLIC POWER AND IRRIGATION DISTRICT

Bids: June 29.

Electric Distribution Systems, Etc.

Sealed proposals will be received at City Hall, Delta, Colorado, Monday evening, June 29th, 8 p.m., for the construction of a Diesel Electric Generating Plant, ornamental street lighting and city distribution systems.

Plans and specifications may be seen at office of Rocky Mountain Engineering Company 230 Wilda Bldg., Denver, Colo., or may be obtained for $15.00 which will not be returned.

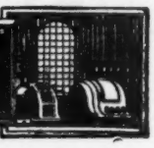
ERNEST C. PORTER,
Consulting Engineer.

U. S. Government

PROCUREMENT DIVISION, Public Works Branch, Washington, D. C., June 11, 1936.—Sealed proposals in duplicate will be publicly opened in this office at 1 p.m., July 9, 1936, for furnishing all labor and materials and performing all work required for the removal and replacement of one freight elevator, etc., in the U.S.P.O. at Jeffersonville, Ind. Attention is directed to the special conditions of bidding set forth in the specification. Drawings and specifications will be supplied free to each contractor interested in submitting a proposal. The above drawings and specifications MUST be returned to this office. Specifications and drawings (if any) will not be furnished to contractors who have consistently failed to submit proposals. One set upon request, and when considered in the interest of the Government, will be furnished builders' exchanges, chambers of commerce or other organizations who will guarantee to make them available for any subcontractor or material firm interested, and to quantity surveyors, but this privilege will be withdrawn if the sets are not returned after they have accomplished their purpose. If the bid is in excess of $2,000, the bidder to whom award is made must, when required, enter into a written contract on the Standard Government form, and furnish performance bond in amount representing 50 per cent of the contract price, within fifteen days after the prescribed forms are presented to him for signature. Said period will be extended only upon presentation to the Contracting Officer, within said period, of reasons which, in the opinion of the Contracting Office justify the extension; and no extension of more than 10 days will be granted. If the written contract and bond are not received within said period, the Government will proceed to have the work required by the specifications performed by any means at its command, and any excess cost to the U. S. will be charged against the bidder to whom the award was originally made. W. E. REYNOLDS, Assistant Director of Procurement, Public Works Branch. (221)

U. S. ENGINEER OFFICE, Clock Tower Building, Rock Island, Illinois. Sealed bids, in duplicate, will be received at this office until 2:00 P.M., June 25, 1936, and then publicly opened, for the construction and installation of a Power, Control and Lighting System at Lock and Dam No. 18, Mississippi River, about seven miles above Burlington, Iowa, including all Central Control Station equipment, lighting equipment, electrical wiring, metal work, masonry, etc. Further information on application. (215)

STEPHEN HALL & CO.
Incorporated
7th and Adams St's. Hoboken, N.J.



SQUIRREL CAGE MOTORS

HP	Volts	Make	Type	Speed
300	2300	G.E.	KT	1,200
250	440–550	G.E.	IE	1,200
200	550	G.E.	IE	900
200	2200–440–220	G.E.	IE	1,200
150	2200–440–220	G.E.	IK	720
100	220–440	G.E.	KT	1,800
100	550	G.E.	KT	900
100	220–440	G.E.	KT	900
75	220–440	G.E.	KT	720
75	220–440	G.E.	KT	900
200	220–440–550	G.E.		600
100	220–440	G.E.		1,200
75	220–440	G.E.		1,200
60	220–440	G.E.		720
60	220–440	G.E.		1,800

SLIP RING MOTORS 3-PH., 60-CY.

HP	Volts	Make	Speed
220	440–220	G.E.	600
200	2200–440–220	G.E.	600
150	220–440–550	G.E.	600
100	550	G.E.	600
100	2200–440–220	Whse.	1,200
100	550	Wagner	720
100	2200–550	Whse.	900
100	440–220	G.E.	900
75	220–440	G.E.	720
60	2200	G.E.	600
50	2200	G.E.	1,200
50	2200–440–220	G.E.	600
50	550–220	G.E.	720
40	2200	G.E.	1,200
40	220–440	G.E.	900

SYNCHRONOUS MOTORS 3-PH., 60-CY

HP	Volts	Make	Speed
350	2200–440–220	G.E.	180
240	2300	G.E.	900
240	2200–440–220	G.E.	600
200	2200/4000	G.E.	514
125	2200–440–220	G.E.	450
125	220–440	Whse.	900
120	2200–440	G.E.	1,200
120	2200–440–220	G.E.	600

DIRECT CURRENT MOTORS

HP	Volts	Type	Make	Speed
250	230	MPC	G.E.	700
100	230	SK	Whse.	625
100	230	LC	G.E.	1,150
80	230	RC	G.E.	600
50	230	CD	G.E.	1,150

TRANSFORMERS—60 CYCLE

3—1250 kva., Brown Boveri, 33000-2300/4000 Y.
3—500 kva., G.E., H-KDD, 13200-2300/4000 Y.
3—500 kva., Allis-Chalmers, 13200-230-460.
3—300 kva., Pittsburgh, 2200-220/110.
3—250 kva., G.E., type H-KDD, 13800-230/460.
3—150 kva., G.E., type H-KD, 4000-230/460.
3—150 kva., Allis-Chalmers 6900/13800-220/440.
3—100 kva., Kuhlman, 2300-460.
3—75 kva., G.E., type H-KS, 2200-110/220.
3—50 kva., Whse. type SK, 13800-120/240.
3—250 kva., G.E., type H-K-KDD, 11970-2300.
1—75 kva., G.E., type H-KS, 4800/2400-240/208/120.
3—50 kva., G.E., type H-KF, 2200-220/110.
3—25 kva., G.E., type H-K, 2200-220/110.
3—25 kva., G.E., type H-K, 2200-220/410.
3—25 kva., G.E., type H-KR, 13800-230/460.

A. C. GENERATORS

1—300 kva., 900 r.p.m., 240-480-V., Al.-Chal.
1—225 kva., 600 r.p.m., 2200-240-480-V., G.E.
1—225 kva., 900 r.p.m., 2300-V., G.E.
1—112½ kva., 1200 r.p.m., 220-480-V., G.E.
1—112½ kva., 900 r.p.m., 240-480-V., G.E.
1—112½ kva., 600 r.p.m., 2200-480-240-V., G.E.
1—100 kva., 1200 r.p.m., 600-V., Whse.
1—100 kva., 900 r.p.m., 240-480-V., Whse.
1—75 kva., 1200 r.p.m., 2200-480-240-V., G.E.
1—75 kva., 1200 r.p.m., 240-480-V., Cr. Wheeler.
1—62.5 kva. 600 r.p.m., 2300-480-240-V., G.E.

MOTOR GENERATOR SETS

1—200-kw., 125-V., 1200 r.p.m., G.E. type MPC, connected to type TS, 300 hp., 2300/440-V., 60-cy., syn. motor.
1—125-kw., 125-V., 1200 r.p.m., G.E. type MPC, connected to type ATI, 165 kva., .8 PF, 220/440-V., 60-cy., syn. motor.
1—75 kw., 125-V., 1200 r.p.m., G.E. type RC, connected to type ATI, 115 hp., 220/440/550-V., 60 cy., syn. motor.

WANTED

150 to 250 Kw. MG Generator Set direct connected to 4000 volt synchronous motor A.C., 60 cycles, 3 phase.

W-488, Electrical World
520 No. Michigan Ave., Chicago, Ill.

U. S. Government

PROCUREMENT DIVISION, Public Works Branch, Washington, D. C., June 3, 1936.—Sealed proposals in duplicate will be publicly opened in this office at 1 p.m., June 30, 1936, for furnishing all labor and materials and performing all work required for installing one freight elevator in the federal jail at Los Angeles, Cal. Attention is directed to the special conditions of bidding set forth in the specification. Drawings and specifications will be supplied free to each contractor interested in submitting a proposal. The above drawings and specifications MUST be returned to this office. Specifications and drawings (if any) will not be furnished to contractors who have consistently failed to submit proposals. One set upon request, and when considered in the interests of the government, will be furnished builders' exchanges, chambers of commerce or other organizations who will guarantee to make them available for any sub-contractor or material firm interested and to quantity surveyors, but this privilege will be withdrawn if the sets are not returned after they have accomplished their purpose. If the bid is in excess of $2,000, the bidder to whom award is made must, when required, enter into a written contract on the standard government form, and furnish performance bond in amount representing 50 per cent of the contract price, within 15 days after the prescribed forms are presented to him for signature. Said period will be extended only upon presentation to the contracting officer, within said period, of reasons which, in the opinion of the contracting officer, justify the extension; and no extension of more than 10 days will be granted. If the written contract and bond are not received within said period, the government will proceed to have the work required by the specifications performed by any means at its command, and any excess cost to the U. S. will be charged against the bidder to whom the award was originally made. Drawings and specification may be obtained at the office of district engineer, W. A. Newman, 232 Federal Office Building, San Francisco, Cal., or at this office in the discretion of the Assistant Director of Procurement, Public Works Branch. W. E. REYNOLDS, Assistant Director. (223)

U. S. Government

PROCUREMENT DIVISION, Public Works Branch, Washington, D. C., June 3, 1936.—Sealed proposals in duplicate will be publicly opened in this office at 1 p.m., June 30, 1936, for furnishing all labor and materials and performing all work required for removal and replacement of one passenger elevator in the U.S.P.O. & Ct. H., extension and remodeling, at Bismarck, N. Dak. Attention is directed to the special conditions of bidding set forth in the specification. Drawings and specifications will be supplied free to each contractor interested in submitting a proposal. The above drawings and specifications MUST be returned to this office. Specifications and drawings (if any) will not be furnished to contractors who have consistently failed to submit proposals. One set upon request, and when considered in the interests of the Government, will be furnished builders' exchanges, chambers of commerce or other organizations who will guarantee to make them available for any subcontractor or material firm interested, and to quantity surveyors, but this privilege will be withdrawn if the sets are not returned after they have accomplished their purpose. If the bid is in excess of $2,000, the bidder to whom award is made must, when required, enter into a written contract on the standard Government form, and furnish performance bond in amount representing 50 per cent of the contract price, within 15 days after the prescribed forms are presented to him for signature. Said period will be extended only upon presentation to the contracting officer, within said period, of reasons which, in the opinion of the contracting officer, justify the extension; and no extension of more than 10 days will be granted. If the written contract and bond are not received within said period, the Government will proceed to have the work required by the specifications performed by any means at its command, and any excess cost to the U. S. will be charged against the bidder to whom the award was originally made. W. E. REYNOLDS, Assistant Director of Procurement, Public Works Branch. (222)

PROCUREMENT DIVISION, Public Works Branch, Washington, D. C., May 28, 1936.—Sealed proposals in duplicate will be publicly opened in this office at 10 a.m., June 25, 1936, for furnishing all labor and materials and performing all work for the furnishing and installing of interior lighting fixtures in the U.S.P.O., Custom House and Court House at Galveston, Texas. Attention is directed to the special conditions of bidding set forth in the specification. Drawings and specifications will be supplied free to each contractor interested in submitting a proposal. W. E. REYNOLDS, Assistant Director of Procurement, Public Works Branch. (216)